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SEMCOG (Southeast Michigan Council of Governments)/Oakland County
Technical Report

Southeast Michigan Council of Governments
Detroit

Prepared for

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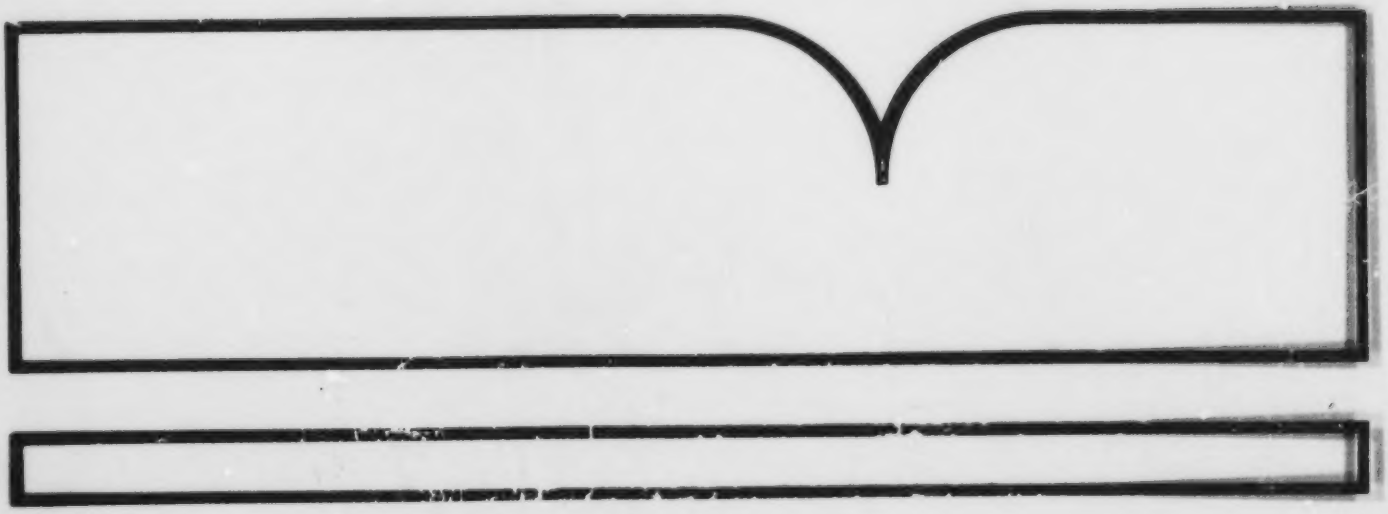

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SEMCOG / OAKLAND COUNTY NURP PROJECT: FINAL REPORT

A Technical Report

August 1983

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SEMCOG/Oakland County NURP Project:
Final Report

August 1983

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Detroit, Michigan 48226

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PREFACE

The Final Report presents the activities and results of a three-and-a-half year US EPA sponsored investigation into the severity and control of urban stormwater runoff water quality problems. The project was one of thirty nationwide which were conducted under the EPA's Nationwide Urban Runoff Program (NURP).

The impetus for SEMCOG participation in NURP derived from a real need in the region to correct significant urban stormwater problems in built-up urban areas and to prevent significant stormwater problems from occuring in the extensive urbanizing fringe areas within the region. This need was identified through water quality management planning efforts conducted by SEMCOG during the development stages of the Water Quality Management Plan for Southeast Michigan, adopted in June 1978.

The overall goals of the SEMCOG/Oakland County NURP project were to: (1) assess the economic, environmental, and social feasibility of incorporating urban stormwater quality enhancement BMPs into the region's extant stormwater quantity management system; and (2) to work towards BMP implementation in the region whenever such implementation was feasible. The focus of the project was an evaluation of dry stormwater detention basins currently used for urban drainage control in many parts of the southeast Michigan region, especially Oakland County. SEMCOG believed that these basins could be easily modified to improve water quality. Initially, SEMCOG also intended to monitor other NURP projects and assess the feasibility of transferring successful BMP's to Southeast Michigan.

In order to attain project goals these objectives were established:

1. To sample urban runoff entering basins, both before and after the basins were structurally modified in order to further characterize the types and quantities of pollutants;

2. To sample basin effluent after modification in order to assess modification effectiveness;

3. To assess the existing stormwater management system in the region and recommend appropriate changes such that any successful BMPs could be implemented.

Due to continuing equipment and weather problems, the project was terminated before all data were collected. Although objectives 1 and 3 above were satisfactorily completed, sufficient after-modification data were not collected to conclude that basins could be modified in a cost-effective manner. Nevertheless, project results showed that urban runoff can be an important contributor of pollutants, detention basins can be easily and inexpensively modified, and the existing regional management system can be used with little or no change to implement stormwater quality control BMPs. In addition, the water quality and management data generated are being used by the EPA as part of its nationwide urban stormwater problem and control assessment.

Due to the early ending of the project only small amounts of water quality data were collected during the project's last year, and, in addition, insufficient data were available from most other NURP projects. Thus, this Final Report is an updated version of the projects' Year Two Annual Report since most data had been collected at the time of the earlier report.

Specifically, post basin modification storm events K and L are added to Chapter II, the descriptions of basin modifications (constructed in the last year) at the end of Chapter III are new, and the discussion of stormwater management options at the end of Chapter IV are added.

A brief project milestone chart is provided to clarify project activities over the last three-and-a-half years.

June 1979	SEMCOG notified of grant approval (Year One)
October 1979	Final test site selection
May 1980	Test basins ready for project sampling
June 1980	SEMCOG notified of grant award for Year II
October 1980	Sampling ended for season (Events A-J)
April 1981	Basin modifications initiated
May 1981	Report: Effective Management Programs: Case Studies of Local Government in Southeast Michigan
June 1981	Report: SEMCOG/Oakland County NURP Project: Year Two Annual Report (Year Three)
June 1981	Basin modification completed
July 1981	Revised technical work plan approved by EPA
August 1981	Year Two data tape sent to EPA
August 1981	Report: A Description and Assessment of Stormwater Management Programs in Oakland County
September 1981	Sampling initiated (Event K)
October 1981	Sampling discontinued due to equipment damage resulting from large storm
November 1981	Report: Management Options for Implementing Stormwater Quality Controls in Southeast Michigan
June 1982	Sampling initiated (Event L)
July 1982	Sampling termination notice
January 1983	Final data type sent to EPA

The urban stormwater runoff problem is significant in Southeast Michigan. The results of this project indicate that control of runoff problems is economically and politically feasible. Financing should be sought to complete this project.

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CHAPTER I: INTRODUCTION

OVERVIEW

The Southeast Michigan Council of Governments (SEMCOG) and the Oakland County Drain Commissioner participated in the USEPA's Nationwide Urban Runoff Program (NURP) in order to further characterize the urban runoff water quality problem in Southeast Michigan and to assess the technical, economic, and political feasibility of incorporating urban stormwater quality Best Management Practices into the urban stormwater quantity management system that exists in the southeast Michigan planning region (See Figures 1 and 2). This report presents summary data, findings, and conclusions developed in a variety of project reports (See Bibliography) during the Project (June 1, 1979 to December 31, 1982).

The remainder of this chapter presents an overview of first the nationwide NURP effort and secondly a summary of the SEMCOG/Oakland County project objectives and methodologies. It is in the larger context of the entire NURP program and the entire local project that the information from the Project is relevant and understandable. Chapter II concerns the selection and characterization of the project's test sites and Chapters III and IV present summaries of project technical and management work efforts respectively.

INTRODUCTION TO THE USEPA's NATIONWIDE URBAN RUNOFF PROGRAM

The intent of this section is to provide a brief summary of the background, objectives, and methodologies of the Nationwide Urban Runoff Program.

The EPA emphasis on urban stormwater quality management resulted from the fact that more than 150 of the initial "208" water quality management plans which state and areawide agencies prepared identified urban storm runoff as a water quality problem. Indeed, SEMCOG's efforts were instrumental in the development of the EPA program. EPA estimates that over 50 percent of the nation's river basins are adversely affected by urban runoff.

Yet, although many 208 plans identified urban runoff as either a known or suspected important cause of water quality problems, there was much reluctance to proceed with corrective measures. First, there was an absence of clear problem definition. The exact role of urban runoff as a major cause of water quality problems remained uncertain despite the fact that 208 plans developed considerable information. This was partly because of interference from other pollution sources and the complex relationships of pollutants within receiving waters. Second, there was uncertainty surrounding the cost and effectiveness of controls which tend either to be new or special applications of conventional practices used for other purposes. State and local officials were understandably reluctant to invest large amounts of time and money in controls which may not effectively reduce pollution. Third, Federal, state, and local statutory authorities and institutional and financing arrangements for implementation were non-existent or ill-defined. All these problems were due to basic data deficiencies.

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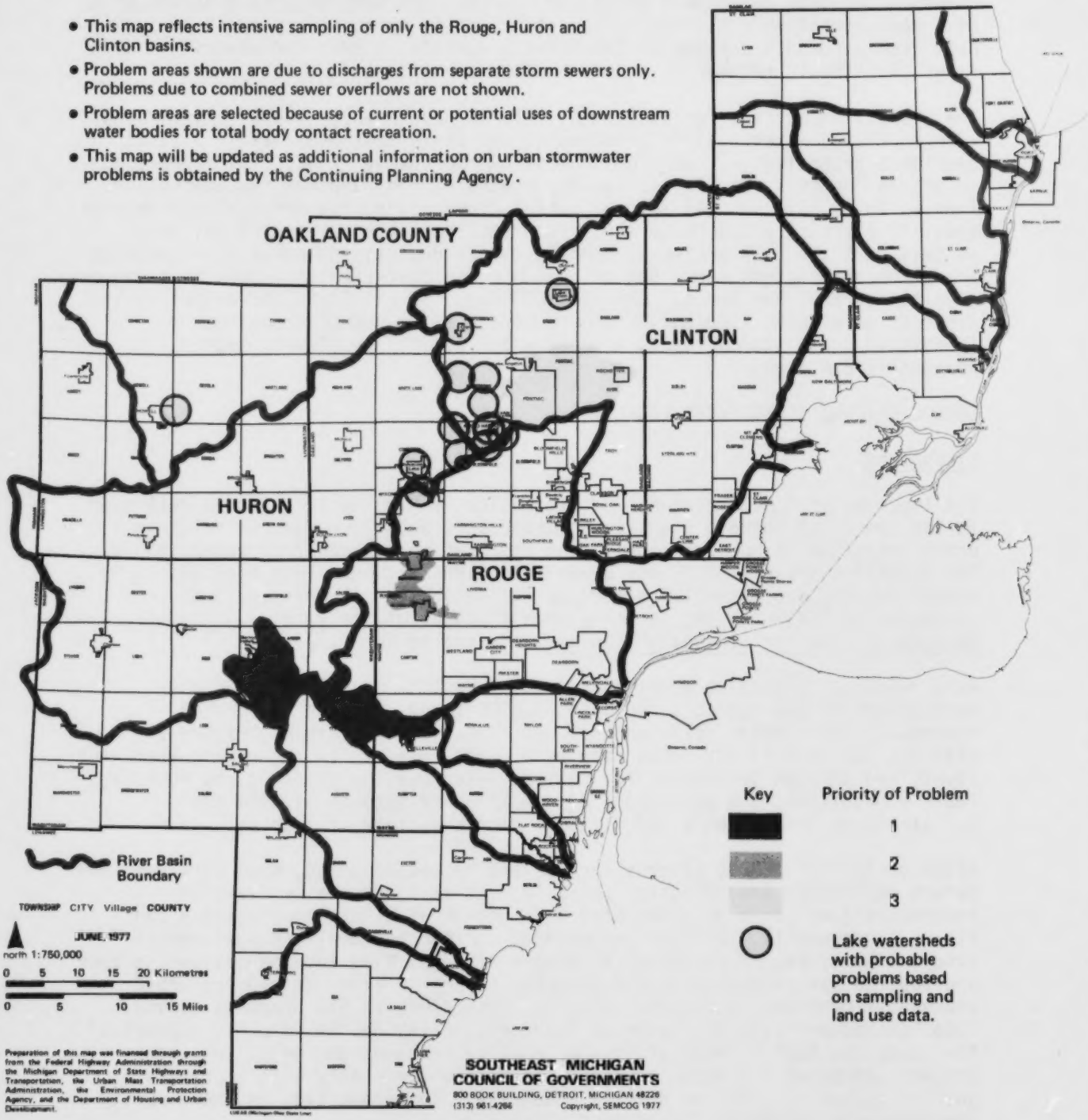
FIGURE 2

URBAN STORMWATER PROBLEM AREAS IN SOUTHEAST MICHIGAN


• This map reflects intensive sampling of only the Rouge, Huron and Clinton basins.
• Problem areas shown are due to discharges from separate storm sewers only. Problems due to combined sewer overflows are not shown.
• Problem areas are selected because of current or potential uses of downstream water bodies for total body contact recreation.
• This map will be updated as additional information on urban stormwater problems is obtained by the Continuing Planning Agency.
OAKLAND COUNTY
CLINTON
HURON
ROUGE
Key
Priority of Problem
1
2
3
Lake watersheds with probable problems based on sampling and land use data.
River Basin Boundary
TOWNSHIP CITY Village COUNTY
JUNE, 1977
north 1:750,000
0 5 10 15 20 Kilometres
0 5 10 15 Miles
Preparation of this map was financed through grants from the Federal Highway Administration through the Michigan Department of State Highways and Transportation, the Urban Mass Transportation Administration, the Environmental Protection Agency, and the Department of Housing and Urban Development.
SOUTHEAST MICHIGAN COUNCIL OF GOVERNMENTS
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Given these barriers to implementation, the EPA initiated a Nationwide Urban Runoff Program designed to establish a consistent data base for urban nonpoint source water quality impacts and to test controls in different geographic settings with the ultimate goal to find a set of transferable, cost-effective controls, or best management practices (BMPs). The NURP program consists of a five year, twenty-six million dollar study during which twenty-eight projects have been conducted nationwide involving a variety of BMPs and covering a wide range of climatic regimes in order to demonstrate transferability.

The overall objectives for NURP in FY '81-'85 have been: (1) to control urban runoff related water quality problems at the state and local level; (2) to develop a technological base for control by the end of FY'82; (3) to make a report to Congress on effects, causes, controls, and required implementation funding in FY'83; and (4) to make, where appropriate, the transition from site specific planning projects to widespread implementation before FY'83, this assumes that the NURP projects identify consistent methodologies for assessing urban runoff problems and a set of feasible and cost-effective BMPs that can be transferred to other areas. EPA used 208 funds in FY '81-'83 to assist in the application of NURP findings in the remaining 120 non-NURP areas that identified urban stormwater as a major water quality problem in their respective 208 plans.

SEMCOG/OAKLAND COUNTY NURP PROJECT

Background

The impetus for SEMCOG regional participation in NURP derived from a real need in the region to correct significant urban stormwater problems in built-up urban areas and to prevent significant stormwater problems from occurring in the extensive urbanizing fringe areas within the region. This need was identified through extensive water quality management planning efforts conducted by SEMCOG during the development stages of the Water Quality Management Plan for Southeast Michigan, adopted in June 1978.

As a result of extensive sampling and water quality modeling during the development of the region's 208 plan, SEMCOG found evidence that urban stormwater was a major pollutant source in southeast Michigan. Figure 2 displays the significant urban stormwater problem areas in the region that were identified through geographically limited water quality sampling and modeling. Table 1 highlights the percentage of annual contributions of selected pollutants to the region's major rivers from a variety of sources.

Although initial SEMCOG efforts were extensive and detailed, much work remained before definitive economically, socially, and environmentally feasible recommendations could be formulated and incorporated into the region's 208 Plan. Consequently, the Plan recommended further regional urban stormwater study. Therefore, in an effort to comply with the Plan recommendations, a NURP application was submitted to and accepted by EPA in order to redress urban stormwater problems in a manner that is cost-effective and amenable to the local characteristics of southeast Michigan. Although the specific subject of the study was NURP-related stormwater quality problems and solutions, the project addressed stormwater quantity issues concomitantly with stormwater quality issues in order to develop integrated, comprehsnsive, and more easily implementable stormwater management strategies.

TABLE 1

PERCENTAGE COMPARISON OF ESTIMATED
ANNUAL POLLUTANT LOADINGS

The Rouge River Basin

Pollutant	Point Sources	Urban Stormwater	Runoff From Grassland	Runoff From Active Cropland	Combined Sewer Overflows
Suspended Solids	42.0	42.0	0.9	4.1	11.0
Biological Oxygen Demand	0.9	18.9	1.0	4.1	75.0
Total Nitrogen	29.9	13.7	2.6	11.8	42.0
Phosphorus	2.9	21.7	1.3	5.6	65.5

The Clinton River Basin

Pollutant	Point Sources	Urban Stormwater	Runoff From Grassland	Runoff From Active Cropland	Combined Sewer Overflows
Suspended Solids	0.4	65.8	2.9	29.7	1.3
Biological Oxygen Demand	9.5	37.8	3.8	39.5	9.4
Total Nitrogen	38.0	11.1	4.2	44.4	2.2
Phosphorus	26.6	28.6	3.3	34.7	6.8

Source: Southeast Michigan Council of Governments

Project Methodology

The overall goals of the SEMCOG/Oakland County NURP project were to: (1) assess the economic, environmental, and social feasibility of incorporating urban stormwater quality enhancement BMPs into the region's extant stormwater quantity management system; and (2) to work towards BMP implementation in the region whenever such implementation is feasible. The focus of the project was an evaluation of dry stormwater detention basins currently used for urban drainage control in many parts of the southeast Michigan region, especially Oakland County. Pursuant to the EPA policies summarized earlier concerning transferability and implementation, SEMCOG also explored the feasibility of implementing in Southeast Michigan other BMPs being tested around the country.

Information generated by the NURP project will be used by SEMCOG in conjunction with relevant work products from other 208 water quality management planning efforts to aid SEMCOG in the development of future basinwide strategies for controlling total urban pollutant loadings to the region's rivers and lakes.

The effort in southeast Michigan was a three-and-a half year (June 1, 1979 to December 31, 1982) study that was organized in conjunction with the Oakland County Drain Commissioner in order to incorporate the experience gained by the Commissioner through his successful administration of programs to enforce the Soil Erosion and Sedimentation Control Act (PA 347) and the Subdivision Control Act (PA 288), both of which often require stormwater detention basins. The Drain Commissioner's function was especially important to the long-term development of sound and comprehensive water resources management strategies since it is the policy of SEMCOG to integrate a system of controls for urban nonpoint pollution into the present framework of laws and practices, wherever possible.

The detention basins assessed in this project are those required under the Subdivision Control Act, Michigan PA 288 of 1967. These controls are required in order to reduce excess runoff from development sites which are tributary to drains with little additional hydraulic capacity. Detention structures are typically designed to protect against the ten-year storm event. These basins are usually no more than holes-in-the-ground and located on outlots at development boundaries. Typically water only ponds in those basins during and after large storm events. Should these structures provide significant improvement in water quality, it may be possible to implement a comprehensive storm drainage program which provides both flood protection and water quality benefits.

The project methodology consisted of an extensive program consisting of a technical study as well as a management study. The technical program was designed to determine mass loadings of pollutants and the degree to which various detention structures and modifications to these structures reduce pollutant discharges from two residential subdivisions and one commercial development in Oakland County, Michigan. The hypothesis tested was that stormwater pollution control in developing areas can be achieved with relatively inexpensive modifications to present practices, specifically detention systems, used in control of stormwater quantity.

Technical

Briefly, the major components of the technical work effort were:

Sites -

Previous SEMCOG studies focused on the problem of characterizing runoff pollutant loads from different land uses. From these efforts, it was concluded that pollutant load characteristics of runoff from commercial and residential areas can differ significantly. Accordingly, this project considered two categories of land use: residential and commercial.

Three test sites were selected in the City of Troy for the purposes of this project (Figure 3). Two of the sites were residential and one was commercial. All were less than 135 acres, had curbs and gutters, and exemplified typical development in many areas of the region and nation. Water from each site drained into a detention basin structure before emptying into a county drain.

The detention basins were grassed holes-in-the-ground with one or more influent pipes and one effluent pipe at the lowest part of the basin. During small storms, water entering the basin moved in a more or less straight line from the inlet to the outlet, without a significant pond of water being created.

Sampling -

Rainfall, basin inlets, and basin outlets were sampled for water quality and quantity. This allowed for quantification of atmospheric pollutant loadings, urban runoff pollutant loadings, and basin efficiencies.

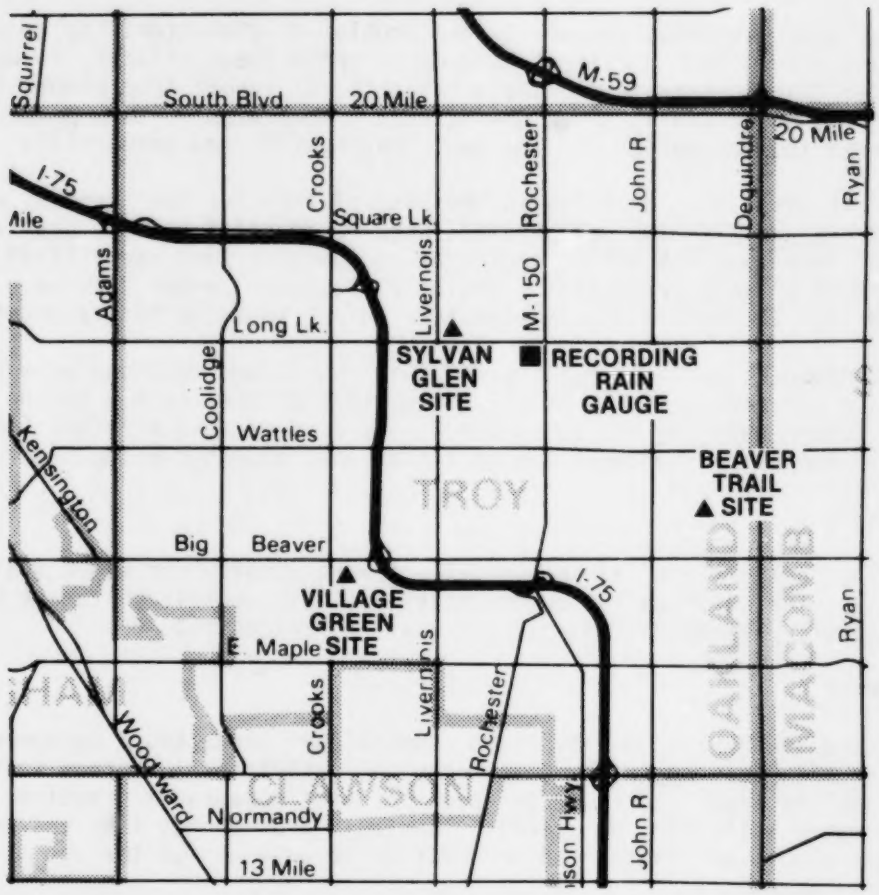
Management

SEMCOG and the Oakland County Drain Commissioner conducted a management planning effort concurrently with technical activities. Whereas technical water quality study addresses the types of best management practices which reduce water pollution, management planning addresses how laws and agency programs should be constructed or modified to provide for the use of the most effective practices.

It has been the experience of SEMCOG that technical recommendations are often ignored unless a specific approach for implementing the recommendations is developed and executed. Thus, to be useful in reducing water pollution, technical findings must be related to laws, agency responsibilities, interagency review procedures, and the political decision-making process. This process of creating the framework for implementing the technical findings is called management planning. Without a strong management planning component, technical studies are of minimal efficacy. This effort is consistent with EPA policy that 208 funds should be directed to projects which will directly result in implementation of pollution controls.

Briefly, the management planning effort consisted of four parts. These were:

FIGURE 3
CITY OF TROY
SAMPLING LOCATION MAP



Detention Basin Management Assessment -

The objective of the Detention Basin Management Assessment was to develop an effective management framework for using detention basins for water quality control. The methodology followed involved an initial investigation of the existing legal and institutional framework for stormwater control in Oakland County. This effort was designed to identify federal, state and local agencies involved with stormwater management; agency roles or programs; the timing of agency involvement; inter-agency interactions; and the legal basis for each agency's participation. Based on this effort, management gaps and shortcomings were identified and alternative management recommendations that would allow for inclusion of quality considerations into the stormwater management system were developed and evaluated for implementability in terms of cost-effectiveness and social acceptance. Although the focus was on Oakland County in this part of the management effort, results were evaluated in regards to BMP implementation throughout the entire region.

During the assessment of the existing stormwater management system the following issues were addressed.

- Public Agency responsibilities,
- Landowners' responsibilities (i.e., homeowner associations and corporations,
- Relevant state laws and local ordinances,
- Costs and responsibilities for financing,
- State, county and local agency coordination typically carried out before decisions on detention basins are made,
- Criteria for determining the need for a basin,
- Technical standards and criteria used in reviewing and approving detention basins,
- On-site problems which have occurred after construction of detention basins (aesthetic, health, liability, etc.),
- Impacts on developers and home-buyers, and
- Recreation and open space opportunities.

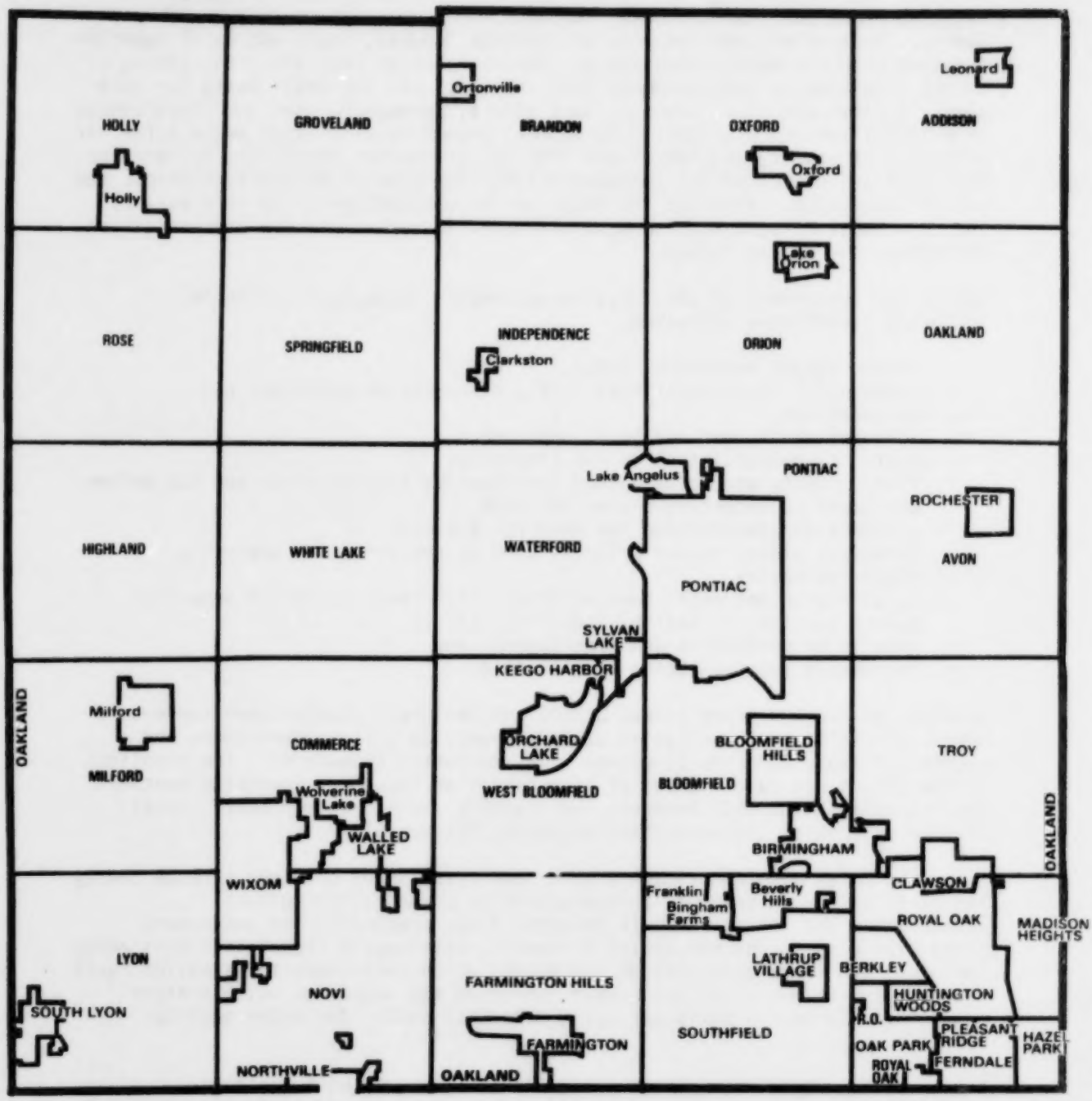
In order to address these issues SEMCOG and the Drain Commissioner surveyed a number of cities or townships in Oakland County as well as developers and county and state agencies concerned with stormwater (Figure 4). The highlight of the effort was case studies of five cities or townships involving meetings and interviews with city managers and township clerks, agency staff, local elected officials, and consulting engineers (Figure 5).

Using the local government case studies and information obtained through county and state agency interviews, an assessment or present institutional arrangements for detention basin management was prepared. The assessment identified gaps in the management framework, overlapping responsibilities among agencies, and intra governmental procedures which contribute to detention basin management problems. The assessment indicated the degree to which present programs could be the basis for using detention basins for water quality purposes.

A detailed legal assessment was conducted concurrently with the basin management assessment. The purpose of this task was to identify the potential for using present State of Michigan laws and local ordinances to implement technical findings related to urban Best Management Practices.

FIGURE 4

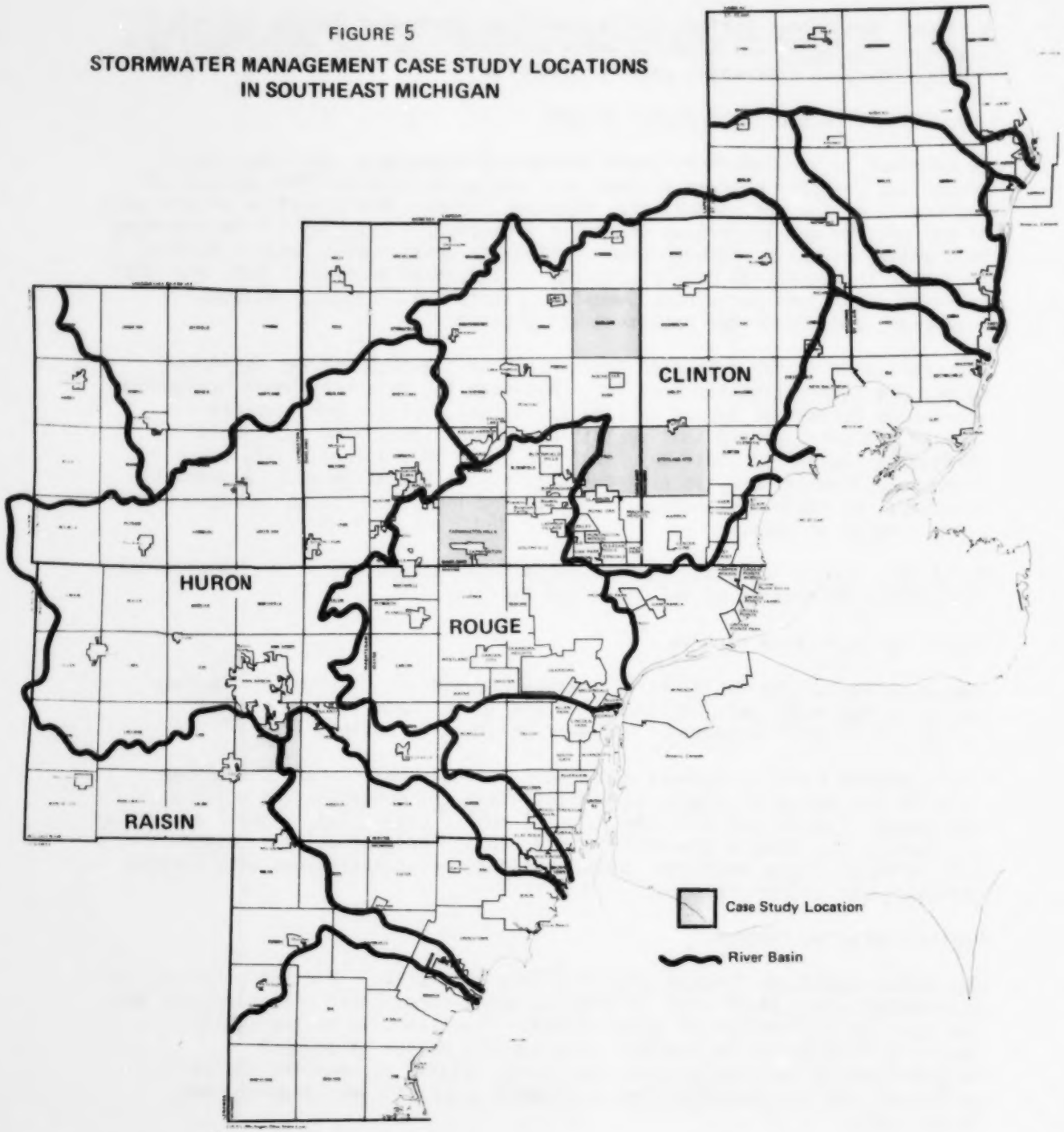
LOCAL GOVERNMENT JURISDICTIONS IN OAKLAND COUNTY



Source: SEMCOG

FIGURE 5

STORMWATER MANAGEMENT CASE STUDY LOCATIONS IN SOUTHEAST MICHIGAN



Source: SEMCOG

SOUTHEAST MICHIGAN COUNCIL OF GOVERNMENTS

A report, Management Options For Implementing Stormwater Quality Controls in Southeast Michigan, was produced which addressed legal and administrtive mans for implementing stormwater quality controls.

Urban Runoff Technology Transfer Program -

In contrast to the Detention Basin Management Assessment, the Urban Runoff Technology Transfer Program focused on a series of selected BMPs potentially applicable to the entire southeast Michigan region. The objective of this part of the program was to develop effective management strategies for implementing BMPs proven effective through other Nationwide Urban Runoff Program studies, including the Washtenaw County project, in southeast Michigan. BMPs evaluated included techniques for street sweeping, catchbasin cleaning, wetlands treatment, and stormwater retention and detention.

The completion of the Detention Basin Management Assessment was essential background information for Part Two. Although the detention basin management assessment focused solely on Oakland County and a single BMP (detention basins), it was expected that certain management issues and implementaion strategies identified would be useful for other BMPs as well. The Urban Technology Transfer Program expanded the initial Detention Basin Management Assessment by reviewing a range of county and local government incentives for using a range of BMPs.

As of this report few other NURP projects have reached definitive conclusions. Therefore, the results of this task are limited.

Public Participation Program -

The objective of the Public Participation Program was to stimulate two-way communication with local elected officials and citizen leaders so that stormwater control recommendations were politically acceptable.

The Detention Basin Management Assessment and the Urban Runoff Technology Transfer Program were structured to facilitate the communication process. Management alternatives were the focus of public evaluation. Public evaluation was carried out through the Public Participation Program which involved continuing series of meetings, communications, and negotiations with elected officials and citizen leaders.

Public Education Program -

The Public Education Program presented local officials, involved citizens, and government agency staff with information about BMPs, their effectiveness, and the need for the control of urban runoff. The objective of the Public Education Program was to educate these publics before management recommendations were formulated. Brochures related to nonpoint source pollution problems and effective management practices were prepared and distributed.

CHAPTER II: SITE SELECTION AND DESCRIPTION

CHAPTER II: SITE SELECTION AND DESCRIPTION

INTRODUCTION

Because the validity of extrapolating the project's technical findings depends upon the specific sites selected, it is useful at this point to discuss how the sites were selected and their land use characteristics. A test site is a stormwater runoff detention basin and the respective contributing drainage catchment. Site selection and description are discussed below.

SITE SELECTION

Following is a discussion of a site selection process.

Geographic Location

A geographic location within Oakland County was selected based on the following criteria:

1) An area of poor drainage - The extreme southeast corner of Oakland County has a long history of inadequate drainage due to very flat topography and rapid urbanization.

2) A well-developed urban area - An area in which commercial and residential test sites would likely be fully developed.

3) An area of poor water quality - A sub-drainage area in southeast Oakland County, the Red Run sub-basin, of known stormwater induced poor water quality was selected.

4) An area within close proximity to a concentration of raingages - SEMCOG's raingage network is well defined in southeast Oakland County.

Based on these four criteria, the City of Troy was selected as an appropriate geographic area in which to locate test sites. Troy has the additional benefits of fenced-in retention basins that are easy to access.

Specific Sites

Specific sites within the selected geographic area were identified based on the following criteria:

1) "Typical" sites - Sites representative of current suburban development.

2) Fully developed sites - These were selected to avoid problems with the impacts of earthmoving activities.

3) Dry, non-pumped (gravity flow outlet) basins - The project focuses on modifying typical stormwater quantity control basins in the region. A majority of these basins are dry and non-pumped.

4) Large areal extent - Larger drainage sites are better than small areas for sampling purposes.

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Three test sites were selected in the City of Troy for the project: Beaver Trail Subdivision, Sylvan Glen Subdivision, and the Village Green Properties (also called Top of Troy - see Figure 3).

SITE DESCRIPTION

The following descriptions are the basins and catchments at the start of the project. Basin modifications are described in Chapter III.

Beaver Trail Catchment Area

Location

The Beaver Trail detention basin serves Beaver Trail Subdivisions No. 2 and No. 3 in eastern Troy, Michigan. The detention basin is located between the subdivisions off Pasedena and Niagara Drives. The subdivisions may be entered from John R or Dequindre, and are situated between Wattles and Big Beaver roads. The catchment area may be entered from Wattles on Winter Drive. The catchment area of the detention basin is comprised of 127.3 acres, which includes the two subdivisions and some open space. The detention basin can be found on the Warren USGS topographic quad sheet. The approximate longitude of the detention basin is 83° 6'30" West and the approximate latitude is 42°34'12" North.

Land Use/Cover

Approximately 75 percent of the catchment area is medium density residential, with 16 percent open space, and 9 percent streets. There are approximately 390 houses on 107 acres of land in the catchment area. The local housing density is 3.6 units per acre. The preliminary 1980 U.S. Census data indicates that Troy currently has an average of 2.7 persons per household. The population of the catchment area is therefore estimated to be 1,053 persons.

The soils of the area are mostly of the Capac and Colwood types. These soils have moderate to moderately low permeability, a high available water capacity, and are in hydrologic soil group B. There is a small amount of area with soils of the Lenawee type which is in hydrologic soil group B/D, and has moderately low permeability, and a high available water capacity. The catchment slope ranges from 0 to 3 percent. The seasonal high water table is from 0 to 2 feet below the surface of the catchment area.

The effective imperviousness of the area is estimated as 11.5 percent. The effective impervious area includes all impervious areas which drain directly to the storm drainage system. Streets and driveways which connect to the storm drainage system are included. The roof tops of the houses in the subdivisions drain to the lawns of the homes.

The street length of the subdivisions is estimated as 7.64 lane-miles. All of the streets have storm sewers and curb and gutter drainage and are 30 ft. wide. Streets in Troy are swept about 3 times per year, catch basins are cleaned about every 18 months. Separate drainage networks exist for the two subdivisions.

Storm Drainage System

All the streets are served by storm sewers, and there are catch basins in many of the backyards to pick up surface runoff. The majority of the storm drains are made of reinforced concrete pipe. The length of the main channel for Beaver Trail Subdivision No. 3 is 3,302 feet. The main channel has an average slope of 0.360 percent. The time of concentration, or the time required for the entire catchment to contribute runoff, for the Beaver Trail No. 3 subcatchment area is 21 minutes. The length of the main channel for Beaver Trail Subdivision No. 2 is 3,352 feet. The main channel has an average slope of 0.125 percent. The time of concentration for the Beaver Trail No. 2 subcatchment area is 24 minutes.

Beaver Trail Detention Basin

The basin is fenced and covers a rectangular area about 400 feet long and 260 feet wide. The basin has two 54-inch reinforced concrete pipe inlets, one from Subdivision No. 2, and one from Subdivision No. 3. The basin has a 16-inch outlet to the Henry Graham Drain.

The basin bottom is graded toward the outlet with an average slope of about 1 percent. The flood pool of the detention basin is triangular. One inlet is about 240 feet from the outlet; the other inlet is about 95 feet from the outlet. The surface area of the water at elevation 626 is 36,680 square feet. The length to width ratios are 1.6 and 0.25 for each respective inlet at elevation 626. The detention basin has grass and weed coverage, and heavy cattail growth between the inlets and outlet. The side slopes on the east and northerly bank have some erosion. The inlet and outlet pipes are in good condition, although the concrete headwalls at the inlets have major cracks.

Sylvan Glen Catchment Area

Location

The catchment area for the detention basin is comprised of 97.0 acres and includes all of the Sylvan Glen No. 2 Subdivision and some areas north of the subdivision. The catchment area is bounded by Livernois, Sunset Plaza Shopping Center, Long Lake Road, Sylvan Glen Subdivision No. 1, Troy Fire Station No. 2, and the Smith Junior High School playground. The subdivision may be entered from Long Lake Road on Berwyck, from Livernois on Hampshire or Stafford Drives, or from Sylvan Glen Subdivision No. 1 on Harwick or Shrewsbury Drives. The detention basin can be found on the Birmingham USGS topographic quad sheet. The approximate longitude of the detention basin is 83°8'41" West, and the latitude is approximately 42°35'31" North.

Land Use/Cover

Approximately 73.8 percent of the area is low density residential, 7.4 percent streets, and 18.8 percent open space -- including part of a baseball field. There are approximately 170 houses on 82 acres of land in the catchment area. The housing density is 2.1 units per acre. The preliminary 1980 U.S. Census data for Troy indicates that there is an average of 2.7 persons per household. The population of the catchment area is estimated to be 459 persons.

The soils of the catchment area are of the Capac and Colwood complex types. This soil type has moderate to moderately slow permeability, a high available water capacity, and belongs to hydrologic soil group B. The catchment surface slopes range from 0 to 3 percent.

The effective imperviousness of the area is estimated as 12 percent. The effective impervious area includes the streets and driveways. The roofs of the houses in the subdivision drain to lawns.

The street length for the subdivision is estimated at 4.96 lane miles. The streets have curb and gutter drainage and are 26 feet wide. Streets in Troy are swept about 3 times per year and catchbasins are cleaned about every 18 months.

Storm Drainage System

All of the steets are served by storm sewers, and there are catchbasins in many backyards to collect surface runoff. The length of the main drainage path is 3,910 feet. The average overland slope is 1 percent. The average slope of the sewered portion of the drainage path is 0.54 percent. The time of concentration for the catchment area is 34 minutes. The majority of the storm drains are constructed of reinforced concrete pipe.

A considerable portion of the path routes flow through small natural open channels to a catchbasin located at the northeast corner of the subdivision. This overland segment is 1,230 feet long.

Sylvan Glen Detention Basin

The basin is fenced and covers about 1-1/2 acres. The basin has one 48-inch reinforced concrete pipe inlet and one 12-inch outlet to Houghton Drain, although there is a connection to Houghton Drain for the baseflow from the catchment area. The base flow connection has been temporarily bulkheaded for this project. The detention basin was designed to receive flows in excess of the base flow.

The basin bottom is graded toward the outlet with approximately a 2 percent slope. The flood pool of the detention basin is rectangular, with the inlet and outlet along one of the shortest sides. The inlet is about 90 feet from the outlet. The length to width ratio for a flood pool at elevation 692 is 0.44. The detention basin is covered with weeds and grass with some cattail growth at the inlet. No erosion in the basin was evident. The inlet headwall and outflow structure are in good condition.

Village Green Catchment Area

Location

The Village Green detention basin collects runoff from a 55.1 acre area including the Village Green of Troy Apartments, the Top of Troy office complex and two adjacent commercial areas. The detention basin is located near the Big Beaver Road interchange with Interstate 75. The detention basin is located adjacent to the southbound entrance ramp of I-75. The catchment area is bounded by the entrance ramp, Big Beaver Road, Crooks Road, and Kirts Road.

The detention basin can be found on the Birmingham USGS topographic quad sheet. The approximate longitude of the detention basin is 83°9'36" West, and the latitude is approximately 42°33'40" North.

Land Use/Cover

The land use of the catchment area is predominantly commercial, consisting primarily of parking lots for the various buildings. There is a small high density residential section (Village Green of Troy apartments), and some open space. Approximately 8 percent of the catchment area is commercial, 28 percent open space (including the detention pond itself), 5 percent high density residential, and 59 percent streets and parking.

The soils of the area are 79 percent Urban Land type. The rest of the area has soil of the Aquents sandy and loamy type. The Urban Land designation means that the area is more than 85 percent covered with impervious features (buildings, parking lots) and the remaining soils can range from sand to clay. Soil properties such as permeability, available water capacity and hydrologic soil group are either too variable to classify or have been obscured by the cover. The Aquents soil type occurs in areas that have been either excavated or filled. Soil properties of the Aquents type are too variable to be rated.

The effective imperviousness of the area has been estimated at 65 percent. The effective impervious area includes all streets, parking lots, and buildings which connect to the storm drainage system.

The street length for the subdivision is estimated as 1.05 lane-miles. The streets have storm sewers and curb and gutter drainage. Streets in Troy are swept about 3 times per year and catchbasins are cleaned about every 18 months.

Storm Drainage System

The parking lots of the commercial areas and apartments are served by storm sewers. The length of the main drainage path is 2,675 feet. The first 640 feet of the drainage path are across an open field. Surface flow from the field enters a catchbasin and is routed through the storm sewer for the remaining 2,035 feet. The main drainage path has an average overland slope of 1 percent and an average sewered slope of 0.48 percent. The time of concentration for the catchment area is 28.2 minutes. The majority of the storm drains are constructed of reinforced concrete pipe.

Village Green Detention Basin

The basin is fenced and covers a trapezoidal area about 280 feet wide and with legs 460 and 400 feet long. The basin has one 54-inch reinforced concrete pipe inlet and a 10-inch corrugated metal pipe outlet. The outlet discharges to Mastin Drain.

The inlet has a concrete headwall and 42-foot long concrete apron. The concrete apron has large cracks and is being undermined by a low flow channel. The inlet and outlet pipes are in good condition. The bottom of the basin is graded toward the outlet at about 1 percent slope. There is standing water near the outlet, and substantial weed and cattail growth near the outlet. Small trees are well established along the edge of the standing water. The grass on the basin sides is 2'-3' high.

The flood pool of the basin is triangular. The distance from the inlet to the outlet is about 190 feet. The length to width ratio at water surface elevation 681 is 0.42. Some erosion of the northerly bank of the detention basin has been noted.

CHAPTER III: TECHNICAL SUMMARY

CHAPTER III: TECHNICAL SUMMARY

INTRODUCTION

This chapter initially presents the methods, materials, and results of all project sampling, both before and after basin modification. The last part of the chapter describes the types of basin modifications that were constructed. Events A-J occurred before modification of basins and events K & L occurred afterwards.

METHODS AND MATERIALS

The project had eight sampling stations; seven at the basins (Beaver Trail has two inlets) and one for precipitation data. Each of the seven basin stations consisted of a Model VMFM265 Marsh-McBirney flow meter coupled to Model 1580 ISCO automatic samplers. These stations were located within the chain-link fence basin confines and secured in protective metal boxes.

The precipitation station consisted of the City of Troy's universal 12" direct timing recording raingage of the weight measure type which was part of SEMCOG's long established raingage network. Each basin also had a manual raingage installed and one basin had a rainfall quality collector (large plastic garbage container) situated in it during early sampling activities.

Upon notification from a commercial weather predicting service, crews went to the basin to monitor equipment. Collection and analysis activities conformed to the project's Quality Assurance Report.

The unreliability of the Marsh-McBirney flow meters caused significant problems for the project. Many events were aborted and flow data that were collected were of such doubtful validity that loading data were not used in project technical reports.

RESULTS AND DISCUSSION

This section presents data summaries and interpretation of the data. The project's complete raw data base is available in other project reports. It should be noted that the project was terminated before sufficient data were collected to allow determination of the effectiveness of basin modifications. Only two events, K and L, were sampled after basin modification.

Summary Data - Quality

This section presents the water quality data that were collected at the three detention basins in Oakland County, Michigan. Twelve storms were sampled during the project period, with various amounts of data obtained from each basin. The influents to the basins and effluents from the basins were metered and sampled during the runoff events. The sampling produced flow-weighted average (composite) concentrations of influent and effluent flows.

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There were continual problems in measuring the flows at the basins. The total influent and effluent volumes were not consistent with one another and/or not consistent with the total volume of precipitation. These inconsistencies did not allow the calculation of reliable loadings from the water quality data. However, removal efficiencies were still estimated using the composite concentrations assuming an equal volume of influent and effluent.

The influents and effluents were originally analyzed for the parameters listed on Table 2. Towards the end of the project several parameters were dropped since their concentrations were so low (e.g., pesticides).

Means and standard deviations were computed for the inlet data collected at the Village Green detention basin and for the combination of data collected at the Sylvan Glen and Beaver Trail detention basins and are compared on Table 3. Levels of pollutants below detection limits are not reported. Removal efficiency by particle size is summarized on Table 4.

The Village Green detention basin has higher mean influent concentrations of chloride, TS, lead, iron, zinc, and copper. The predominant land use of the Village Green catchment is parking, so it is no surprise that the Village Green detention basin has the higher mean influent concentrations of most metals sampled. The predominant land use of the Sylvan Glen and Beaver Trail detention basin catchment areas is residential.

The return frequency of the storms for which the influents and effluents were sampled were all below two years. One storm was estimated to have a return frequency greater than one year. Two other storms had return frequencies that approached one year. Return frequency of the storm was estimated using a rainfall intensity-duration chart for the Detroit area.

Precipitation quantity and quality were also measured. Precipitation quantity was measured for each event at the detention sites and at the SEMCOG rain gage near the intersection of Long Lake and Rochester Roads. Rain quality samples were collected at the sites for earlier storms. Precipitation quality data are summarized in Table 5.

Summary Data - Efficiencies

Removal efficiencies were calculated with the following relation:

$$\frac{\text{Influent Conc.} - \text{Effluent Conc.}}{\text{Influent Conc.}} \times 100.$$

Removal efficiencies for the detention basins for all constituents were calculated from the influent and effluent concentration data and are shown in Tables 5 and 6.

The settling performance of each detention basin was evaluated using the data shown on Table 5 and Table 6. The Village Green detention basin consistently settled suspended solids since a small permanent pond of water existed in the basin due to the design of the outlet structure. Note in Table 4 that this basin had good efficiencies even before modification. The Village Green

TABLE 2

WATER QUALITY PARAMETER LIST

Parameter	Abbreviation
Biochemical Oxygen Demand	BOD
Total Organic Carbon	TOC
Chemical Oxygen Demand	COD
Total Phosphorous	Total-P
Orthophosphate	Ortho-P
Total Kjeldahl Nitrogen	TKN
Nitrites and Nitrates	No_2 & NO_3-N
Ammonia Nitrogen	NH_3-N
Metals	
Chromium	Cr
Copper	Cu
Cadmium	Cd
Lead	Pb
Zinc	Zn
Arsenic	As
Iron	Fe
Nickel	Ni
Mercury	Hg
Pesticides	
Alpha-BHC	
Beta-BHC	
Delta-BHC	
Gamma-BHC	
Heptachlor	
Aldrin	
Heptachlor Epoxide	
DDE	
DDD	
DDT	
Alpha-Endosulfan	
Dieldrin	
Endrin	
Chlordane	
Methoxychlor	
Total Suspended Solids	TSS
Total Dissolved Solids	TDS
Fecal Coliform	FC
pH	
Chloride	Cl
Particle Size Analysis	
<2, 2-4 um	Clays
4-8, 8-16, 16-32, 32-63 um	Silts
63-125, > 12.5 um	Sands

TABLE 3
SUMMARY OF INLET WATER QUALITY DATA

	CHLORIDE (mg/l)	TOTAL ORGANIC CARBON (mg/l)	BIO-CHEMICAL OXYGEN DEMAND (5-DAY) (mg/l)	CHEMICAL OXYGEN DEMAND (mg/l)	TOTAL PHOSPHOROUS (mg/l)	ORTHO-PHOSPHATE (mg/l)
Village Green (Commercial)						
Mean	47.47	32.4	51.5	99.3	.158	.072
Std. Dev.	48.8	36.3	86.1	100.	.081	.071
Sample Size	9.	10.	8.	9.	10.	10.
Sylvan Glen and Beaver Trail (Residential)						
Mean	18.24	48.	70.	204.11	.2956	.1856
Std. Dev.	8.65	80.73	103.6	226.50	.258	.122
Sample Size	10.	9.	7.	9.	9.	9.

	TOTAL KJELDAHL NITROGEN (mg/l)	TOTAL AMMONIA (mg/l)(	TOTAL NITRITE & NITRATE (mg/l)	TOTAL SOLIDS (mg/l)	TOTAL SUSPENDED SOLIDS (mg/l)	TOTAL DISSOLVED SOLIDS (mg/l)
Village Green						
Mean	1.25	.437	.736	311.9	148.9	163
Std. Dev.	.785	.306	.203	115.19	72.5	96.1
Sample Size	10.	9.	9.	10.	10.	10.
Sylvan Glen and Beaver Trail						
Mean	1.58	.195	1.05	330.8	111.7	219.1
Std. Dev.	1.06	.199	.64	71.45	79.82	58.14
Sample Size	9.	9.	8.	9.	10.	10.

	TOTAL LEAD (u/gl)	TOTAL IRON (ug/l)	TOTAL ZINC (ug/l)	TOTAL COPPER (ug/l)	TOTAL ARSENIC (ug/l)	FECAL COLIFORM (MPN/100 ml)
Village Green (Commercial)						
Mean	56.9	4900.	69.3	14	3.39	4303.
Std. Dev.	35.7	2682.	34.6	8.21	3.51	4381.
Sample Size	10.	10.	8.	10.	8.	9.
Sylvan Glen and Beaver Trail (Residential)						
Mean	11.83	1921.67	20.8	7.33	4.74	32,167.14
Std. Dev.	10.54	536.29	6.83	2.66	1.53	31.882.68
Sample Size	6.	6.	5.	6.	5.	7.

PARTICLE SIZE

	0-2u (%)	2-4u (%)	4-8u (%)	8-16u (%)	16-31u (%)	31-62u (%)	62 (%)
Village Green							
Mean	5.92	9.96	19.28	47.	20.72	7.02	5.1
Std. Dev.	2.59	4.84	5.7	6.53	8.8	3.69	4.1
Sample Size	10.	10.	10.	10.	10.	10.	10.
Sylvan Glen and Beaver Trail							
Mean	6.86	10.39	19.65	26.45	18.08	4.11	7.2
Std. Dev.	5.26	6.31	8.12	9.	15.69	4.94	5.15
Sample Size	8.	8.	8.	8.	8.	8.	8.

TABLE 4

PARTICLE SIZE
REMOVAL EFFICIENCY ANALYSIS

	PRECIPITATION		INFLUENT				EFFLUENT				REMOVAL EFFICIENCY (Percent)			
EVENT	Total (in.)	Duration (hr.)	TSS (MG/L)	Concentration (MG/L) Sand	Silt	Clay	TSS (MG/L)	Concentration (MG/L) Sand	Silt	Clay	TOTAL	SAND	SILT	CLAY
VILLAGE GREEN DETENTION BASIN (Commercial)														
B	.39	1.25	180	10	150	20	160	2	72	86	11	80	52	-330
C	.75	.5	180	28	121	31	100	11	79	10	44	61	35	68
D	.18	1.25	150	9	117	24	41	4	34	3	73	56	71	88
E	.85	7.0	120	5	92	23	58	2	50	6	52	60	43	74
F	.54	5.0	280	15	201	64	130	2	98	30	54	87	51	53
H	.36	6.5	23	3	15	5	13	2	7	4	43	33	53	20
I	.55	2.0	140	32	92	16	28	1	21	6	80	97	77	60
J	1.05	1.6	160	36	83	41	130	3	85	42	19	92	-2	-5
*K	.22	8.0	56	3	45	8	19	1	15	3	66	67	67	63
*L	.08	7.0	200	2	197	1	74	5	66	3	63	-150	67	-200
Mean			148.9	14.3	111.3	23.3	82.6	3.4	55.8	23.4	44	70.8	47.5	3.5
Std. Dev.			72.5	12.9	59.8	18.7	54.7	3.2	32.8	28.9	23.7	21.9	24.2	138.
BEAVER TRAIL DETENTION BASIN (Residential)														
A	.39	3.5	78				61				22			
E	.87	2.75	61	8	47	6	51	9	37	5	16	-13	21	17
F	.51	5.0	193				45				77			
G	.28	2.25	50				360				-620			
J	.95	1.6	82	21	51	10	67	3	36	28	18	86	29	-180
Mean			92.8								-97.4			
Std. Dev.			57.5								293.2			
SYLVAN GLEN DETENTION BASIN (Residential)														
F	1.2	5.0	90	5	72	13	95	2	75	18	-6	60	-4	-6
G	.32	2.25	27	4	20	3	36	6	26	4	-33	-50	-30	-33
J	1.00	1.75	150	30	71	49	160	9	121	30	-7	70	70	39
*L	.20	7.0	270				130							
Mean			134.25								-15.3			
Std. Dev.			103.5								15.3			

* Data collected after basins modified. Data used in influent calculations only.

Sand = 63-125, >125u
Silt = 48,8-16, 16-32, 32-63u
Clay = 62, 2-4u

TABLE 5

PRECIPITATION QUALITY SUMMARY

PARAMETER & UNITS	NUMBER OF SAMPLES	PRECIPITATION CONCENTRATION RANGE	MEAN
TKN, mg/l	4	0.53-0.86	0.72
NH3-N, mg/l	5	0.40-0.64	0.53
TOTAL P, mg/l	5	0.02-0.70	0.09
PB, ppb	5	10-29	16
FE, ppb	4	44-500	254
ZN, ppb	4	9-66	28
CR, ppb	4	5-8	5.7
CU, ppb	5	5-10	7.0
BOD_5, mg/l	2	1-6	3.5
COD, mg/l	1	---	0.7
NO2 & NO3-N, mg/l	3	0.38-0.70	0.59
CL, mg/l	3	0.3-0.45	0.38
TOC, mg/l	4	4-10	7

ppb = parts per billion (micrograms per liter)

TABLE 6

REMOVAL EFFICIENCY OF THE DETENTION BASINS
(in Percent)

	BOD-5	TOC	COD	Total P	Ortho P	TKN	NH3-N	NO2 & NO3-N	TSS	TDS	PB	FE	ZN	CR	CD	CU	NI	AS	HG
Village Green																			
Event																			
B	84	71	73	22	-	19	36	-	11	23	53	-71	39	-15	-	12	8	-	-
C	30	-13	46	29	-155	13	-8	-6	44	36	44	46	19	100	0	38	100	61	-
E	-1,200	-900	-383	-25	-80	13	56	3	52	0	72	47	58	22	100	44	-	39	-
F	-35	-94	-81	50	9	30	58	-2	54	0	68	38	-	-572	-33	29	-	12	-
H	-71	46	61	20	0	33	44	-	43	15	-	-39	79	-	-	70	-	-	-
I	0	-13	43	50	0	70	50	-37	80	-42	70	66	22	50	0	50	0	0	0
J	-	-17	0	33	-6	19	-5	-22	19	-117	-32	10	7	64	-	-10	-	38	0
K*	-	-6	12	33	66	70	-	-	66	-37	-	36	53	11	-	-100	-	0	-
L*	-43	-17	35	38	15	41	18	-29	63	-60	57	27	-	-	-	42	-	-	-
Beaver Trail																			
Event																			
A	33	14	86	-6	-36	12	-10	-	22	38	35	31	100	-	-	100	-	4	-
E	-700	-104	47	-36	59	0	33	0	20	-5	9	32	28	-	-	-40	-	18	-
F	-39	17	-35	-256	43	-98	-625	-279	77	-2	-	-	-	-	-	-	-	-	-
H	-59	-	-	-	-11	-	-	-	-1,213	-11	-	-	-	-	-	33	-	-	-
J	-	-6	2	-10	-9	11	-27	17	18	35	-	8	27	11	33	-	-	-27	64
Sylvan Glen																			
Event																			
F	14	-50	-8	12	-67	0	11	24	-6	26	100	-23	-	-	57	0	-	0	-
G	42	67	33	23	0	8	-100	26	-33	32	-	-36	0	-	100	-17	-	-	-
J	-	29	92	-50	-68	-14	19	-18	-7	25	-13	-70	0	-29	0	-50	-	100	-50
L*	67	-	54	48	-14	44	12	-11	52	-23	-	-	-	-	-	-	-	-	-

*Data collected after basin modifications.

detention basin had a large volume with a large surface area and a restrictive outlet. Settling consistently occurred because ponding occurs for both small and large runoff events. The pond which formed during storms has a large surface area and short-circuiting was not identified as a problem.

The Beaver Trail detention basin did not consistently remove suspended solids before modification. In fact, for two of six events that were sampled, solids were clearly picked up by the runoff passing through the basin. The two events had effluent solids concentrations six and twelve times the influent solids concentrations. These two events also had the smallest two precipitation volumes. Resuspension, erosion and scour occurred for the small volume runoff events. The Beaver Trail detention basin outlet had a large capacity relative to the other basin outlets. The detention basin had a substantial volume and surface area, but because of the relatively large outlet capacity, ponding did not occur for small storms.

There was some settling of suspended solids in the Beaver Trail detention basin for the larger volume runoff events. However, there were only two events for which the particle size breakdown is available, which made it difficult to tell exactly what was happening in the basin. The Beaver Trail detention basin had two inlets; one very close to the outlet and short circuiting for this inlet was expected to be occurring.

The Sylvan Glen detention basin did not remove suspended solids. The detention basin had a relatively small volume and small surface area. The outlet of the basin was very close to the inlet, thus short-circuiting was a severe problem. The removal efficiencies from the particle size analysis indicate an increase in solids concentration through the basin for all events sampled, although the increase in milligrams per liter was relatively small. Resuspension and some scour was occurring.

To determine which pollutants were associated with suspended solids, suspended solids removal efficiency was compared to the removal efficiency of other constituents for the Village Green detention basin. Only the Village Green detention basin was considered in this analysis since the detention basin was the only basin which settled consistently. The number of times which the efficiencies had the same sign was counted. The sign of the removal efficiencies of zinc, total phosphorous, copper, TKN, lead, arsenic, and ammonia covaried with the sign of TSS removal efficiency more than 75% of the time.

In an earlier study conducted by SEMCOG, suspended solids concentration was correlated to concentration of other pollutants using a data set of over 300 stormwater samples. Simple linear regression equations were found which related suspended solids concentration to the concentration of other constituents. The constituents which had good correlations (R greater than .77) were total organic nitrogen, total phosphorous, lead and iron. Ammonia and BOD_5 had fair correlations (R greater than .66) to suspended sediment. Thus the results of the earlier study are supported.

Insufficient data were collected to derive meaningful conclusions regarding basin modification efficiencies. Based upon the consistent settling of pollutants at the Top of Troy, including before modification, and the increased settling at all basins after modification, modification of basins appears to be a promising method for stormwater control.

DETENTION AND RETENTION BASINS

The last section of Chapter III describes the technical aspects of the basin modifications constructed in June 1981. Although valid conclusions regarding modification efficiencies could not be made due to insufficient sampling data, the modification designs are detailed in this section to show the types of designs that could be useful for stormwater quality and quantity control.

In many parts of the Southeast Michigan region stormwater runoff from developed areas has overtaxed the capacity of county drains and/or local streams such that drainage problems have occurred. A common remedy is to construct a stormwater detention or retention basin to store the bulk of the runoff and release it at a rate slow enough so as to not cause drainage problems. Detention ponds are typically dry holes-in-the-ground that hold water for short periods whereas retention ponds are typically wet ponds that hold water for relatively longer periods.

The SEMCOG/Oakland County NURP Project focused on dry detention basins, particularly how these types of basins could be inexpensively modified to become urban BMPs. Since the basins were designed solely for quantity control, several obstacles had to be overcome in order to allow the basins to function for quality control also. Quality improvement requires calm standing water so that suspended solids can settle out.

Evaluation of the performance of three study basins in Oakland County during rain events revealed the following problems for quality control:

- turbulence - the stormwater runoff entering the basins was moving rapidly and was highly agitated. Nothing in the basins acted to calm this runoff such that solids in the stormwater entering the basins could settle out and solids on be basin bottoms were not resuspended. Often more solids exited a basin than entered during a storm.

- short circuiting - in all detention basins there is a direct connection between in flow storm sewer pipes and basin outflow pipes such that during most rain events runoff simply enters the basin and immediately exits at high velocity, thus encouraging resuspension and not providing adequate settling time.

DETENTION BASIN MODIFICATIONS - GENERAL DESIGN FACTORS

The basic strategy to improve the quality performance of detention basins is to create a calm pond of water and to allow enough time for solids to settle. The constraints placed upon the development of basin modifications for the three specific project study basins consisted of the following:

- basin modification could not violate the original basin design standards. The study basins were designed to control the 10-year storm event, or that event expected to be equalled or exceeded on the average of once every ten years.

- the average depth of the settling pool needed to be at least one foot to reduce turbulence and resuspension.

- the time to drain the basins needed to be 24 hours since there is a sixty percent chance that there will be no more than one dry day between storms. When basins do not empty, both the treatment provided to the runoff and the flood control capability of the basin are reduced.

- the design storm was chosen to be the 2-year storm since the majority of the pollutant load reaching receiving waters will result from small frequent storms.

DETENTION BASIN MODIFICATIONS - VILLAGE GREEN

The Village Green (Top of Troy) detention basin received runoff from a commercial development in the City of Troy. Although the basin was designed to be dry, there was a small, permanent, one-foot deep pool near the outlet. Due to the pond, settling did occur before the basin was modified and on the average approximately 50% of the suspended solids in the storm runoff were settled in the basin.

The modification to the basin is shown in Figure 6. The only modification was the installation of a stone berm around the outlet pipe designed to increase the depth of the pond and to assure a smoother exiting of basin water such that resuspension was minimized. The berm needs to be cleaned about once a year with high pressure water.

DETENTION BASIN MODIFICATIONS - BEAVER TRAIL

The Beaver Trail basin received runoff from two residential subdivisions in Troy. Two modifications were installed at this site; one at an inlet and one at the basin outlet (see Figure 7). These modifications are:

- a vertical pipe riser installed at the outlet to create a temporary settling pool (bottom of Figure 7). Holes are located on top of the riser for high flows and holes are located at the bottom of the riser (and covered with stone) to drain the basin dry. The metal gate visible in the lower right corner of the bottom picture in Figure 7 is an auxiliary outlet and the mahole structure to the left of the gate was necessary only to connect the riser to the original outlet pipe and would not be required if the modifications were original installations; and

- an inlet stone baffle installed near one of the inlet pipes that was immediately near the outlet and created resuspension and short-circuiting problems at the outlet. The baffle is shown in the top pictures of Figure 7.

DETENTION BASIN MODIFICATIONS - SYLVAN GLEN

The Sylvan Glen basin receives runoff from a residential subdivision in Troy. Since the inlet pipe was so close to the outlet, with about 15 years separating the two, extensive changes were required including:

FIGURE 6
TOP OF TROY BASIN AND MODIFICATIONS

FIGURE 7
BEAVER TRAIL BASIN AND MODIFICATIONS

- installation of a riser pipe with a trash rack and baffle at the top (see Figure 8) was installed approximately 100 feet away from the original outlet. Again the objective was to prevent short-circuiting and create a settling pool, and increase retention time. The trash rack prevents large debris from clogging the riser and associated pipes and the baffle minimizes water turbulence, and thus resuspension, as water exits the basin, and

- an underdrain system was installed where the new pipe entered the old outlet pipe so that the basin would drain dry. Figure 8 shows this underdrain, to the left of the manhole, which was a section of pipe with perforation and covered with stone. Again a manhole structure was required to connect the new pipe to the old and an auxiliary gate was installed. It was especially important to securely fasten pipes to the basin bottom since strong buoyant forces are exerted by the ponded water.

FIGURE 8
SYLVAN GLEN BASIN AND MODIFICATIONS

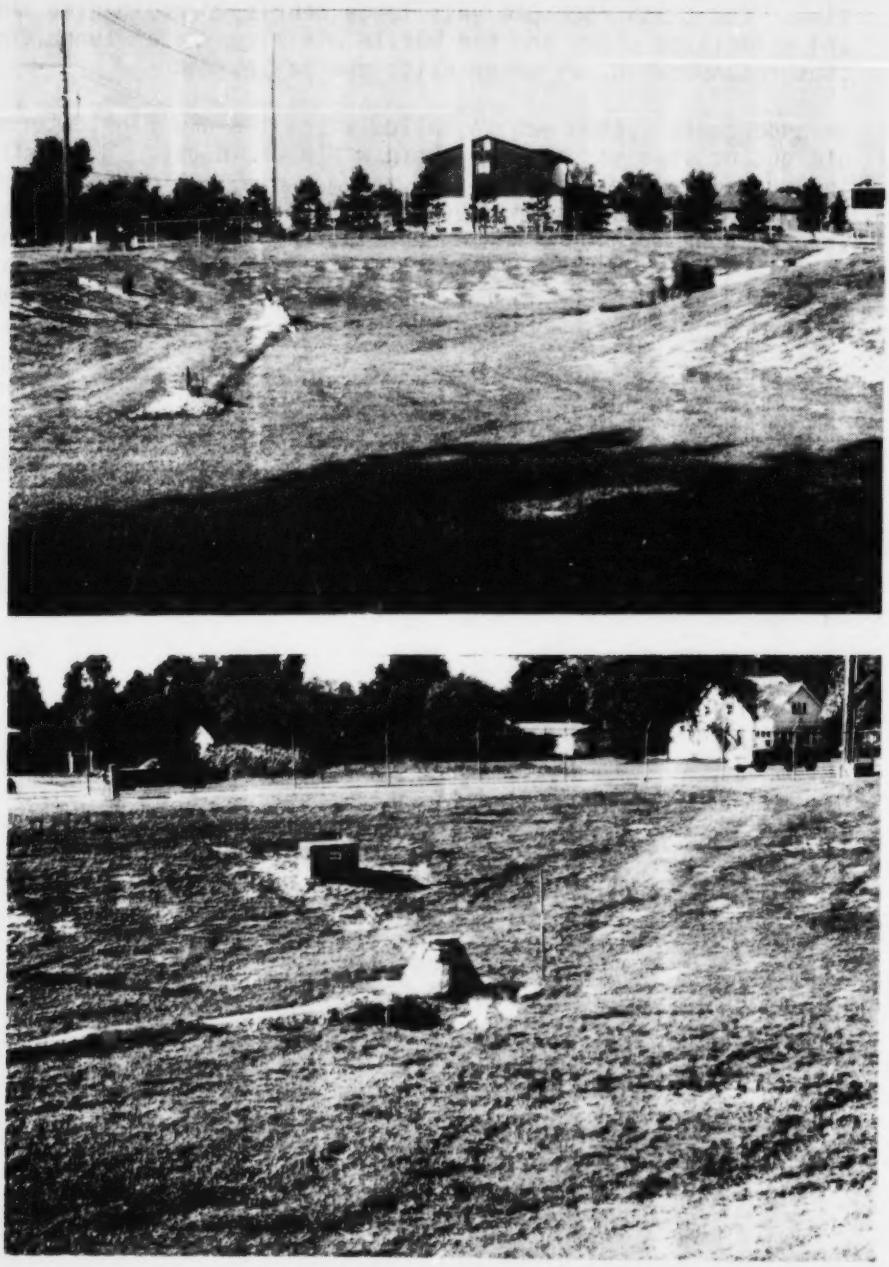
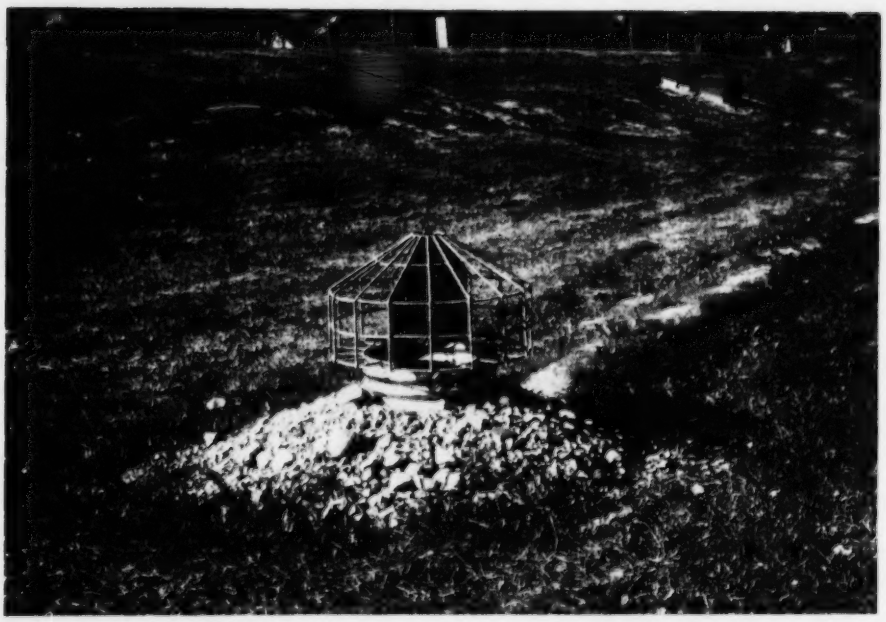


FIGURE 8 (Continued)
SYLVAN GLEN BASIN AND MODIFICATIONS



CHAPTER IV: MANAGEMENT SUMMARY

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CHAPTER IV: MANAGEMENT SUMMARY

INTRODUCTION

In order to assess the feasibility of implementing NURP results in the southeast Michigan region an extensive institutional and legal analysis was conducted. By investigating current stormwater quantity practices in the region, management recommendations were developed to allow for integration of stormwater quality control into the existing quantity management system. The following sections present summary information from three reports produced during the project, these being A Description And Assessment Of Stormwater Management Programs In Oakland County (The Oakland County Report), Effective Stormwater Management Programs: Case Studies Of Local Government Experiences In Southeast Michigan, (The Case Study Report), and a legal opinion concerning stormwater quality control. The summary from the Case Study Report in effect summarizes the findings from the Oakland County Report and the Case Study Report in the form of guidelines for effective local government stormwater management programs. In addition, a summary of management program options is presented that provides implementation information for local governments.

SUMMARUY OF MAJOR FINDINGS FROM THE OAKLAND COUNTY REPORT

Programs and policies administered by federal, state, county, and local agencies which affect stormwater management in Oakland County (see Figure 4) are summarized below. The findings are organized into two categories: findings related to the overall institutional system (that is, the types of laws and programs which provide for stormwater management) and findings related to policies followed by Oakland County communities.

An Institutional System for Stormwater Management

1. With the exception of the Soil Erosion and Sedimentation Control Act (Act 347, P.A. of 1972), Michigan state laws do not require stormwater management for water quality purposes. The soil erosion and sedimentation control requirements, however, primarily apply to the construction phase of development. Permanent stormwater detention or retention facilities or other stormwater control measures to enhance water quality are not required.

2. Although a single state law does not provide for stormwater management for water quality purposes in a comprehensive way, the Subdivision Control Act (Act 288, P.A. of 1967) does establish an institutional system for stormwater management. As required by the Act, drain commissioners in each county review subdivision plats to insure that adequate drainage is provided. The approach to be used for stormwater management and drainage, however, is not specified in the law or related guidelines of the Michigan Department of Treasury. The Oakland County Drain Commissioner has elected to administer rules which encourage on-site retention of stormwater and other polices which benefit water quality. The purpose of the Oakland County program, however, is water quantity control...not water quality.

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3. The Subdivision Control Act and zoning enabling legislation for cities, villages, and townships are sufficiently broad to allow local governments to review development proposal for stormwater management purposes. When local governments review developments for stormwater management purposes, they typically apply technical requirements to all types of developments, including small and large site plans and subdivision plats.

   Twenty-eight of the thirty-five Oakland County townships and cities surveyed indicated that they apply stormwater retention and detention requirements to all development proposals. Local governments, therefore, strongly feel that stormwater management is a local responsibility as well as a county responsibility.

4. Although several state and federal laws affect stormwater management practices in Oakland County, these laws typically focus on resource protection -- not the management of runoff before or after it leaves the resource area (such as wetlands and floodplains).

5. Therefore, as a result of the Drain Commissioner's subdivision plat reviews (required by the Subdivision Control Act) and stormwater management programs which local governments have elected to develop, an institutional system for stormwater management on a county-wide basis exists in Oakland County. The institutional system which is in place provides for the management of stormwater from new developments, and applies to both site plans and subdivision plats in most local jurisdictions.

6. Although a county-wide institutional system for stormwater management has developed in Oakland County, there is no mechanism for implementing technical standards and policies throughout the county, apart from the Oakland County Drain Commissioner. The Oakland County Drain Commissioner's policies, of course, apply to subdivision plats throughout the county. Although the Oakland County Drain Commissioner influences local government standards and policies, the Drain Commissioner does not review and approve those policies.

   The influence and importance of the Drain Commissioner as a central source of technical information and advice, however, should not be discounted. In Oakland County, it is believed that the retention policies of the Drain Commissioner have had a strong effect on the stormwater retention requirements of local governments.

7. Although many local governments in Oakland County require on-site detention and retention of stormwater (and other stormwater management requirements), nearly half of the local governments surveyed have not adopted ordinances or engineering design standards related to stormwater management. The lack of adopted stormwater standards weakens local government enforcement capability and raises questions about the permanency of the requirements.

8. Few local jurisdictions have stormwater management planning programs. This gap is a significant weakness in the present institutional system for stormwater management in Oakland County. Planning programs could serve the purpose of identifying solutions to recurring stormwater problems, and could provide information to guide technical stormwater reviews.

9. Many local governments in Oakland County (as well as the Oakland County Drain Commissioner) are concerned about adequate maintenance of stormwater facilities such as retention and detention basins. Many local governments depend upon property owner associations to provide maintenance for subdivision plats. Basin maintenance for other sites, however, is typically the responsibility of the individual property owner. The lack of community-wide provisions for retention basins maintenance (in most cases) is believed to be a significant gap in the present stormwater management system.

10. Many storm drains in Oakland County are not maintained by any government agency. Although local governments sometimes undertake emergency cleaning operations, most local governments do not have storm drain maintenance programs. The lack of responsibility for maintenance is a gap in the legal and institutional structure.

Stormwater Policies and Technical Measures with Water Quality Benefits

1. With the exception of erosion control permits, present stormwater management requirements developed by the Oakland County Drain Commissioner as well as requirements of most local governments are directed toward stormwater quantity control -- not stormwater quality. Many technical methods used in Oakland County, however, have significant stormwater quality as well as quantity benefits.

2. Three policies which have significant stormwater quality benefits and which are widely practiced by Oakland County communities include:

   - Retention or detention of stormwater on the site, with discharge to a receiving body at a pre-development or agricultural rate (0.2 cfs/acre). Eighteen townships and ten cities require storage volume for a 10-year frequency storm at a minimum. Eleven local governments require 100-year frequency storm volume retention for basins with no outlet, and five local governments require the equivalent of a 100-year frequency storm volume (or more) for all basins.

     Adjustments in stormwater retention and detention requirements are sometimes made when a large river is adjacent to the site. In most cases, however, local governments apply the standards to nearly all development proposals.

   - Natural infiltration of stormwater on the site encouraged by the use of swales, depressions, and natural areas for detention. Fifteen townships and four cities actively encourage natural infiltration of stormwater on the site. The technical approach used to encourage natural infiltration varies with individual sites, reflecting varying natural conditions. The fact that many Oakland County areas have soils which are conducive to natural infiltration has helped support this approach.

- Open spaces maximized, including wetlands and floodplain protection. Although most open space preservation efforts and policies are not directed toward stormwater management, they have important stormwater quality and quantity control benefits. Many townships have a cluster development option (or planned unit development option) in their zoning ordinance, although cluster development is most prevalent in the rapidly urbanizing areas with rising land values. Approximately half of the local governments surveyed have wetlands protection policies, although only five have adopted wetlands protection ordinances.

In addition to these policies, many local governments in Oakland County review grading plans submitted with development plans for erosion control as well as runoff control purposes.

3. The Oakland County Drain Commissioner addresses engineering aspects of stormwater control and management when completing subdivision plat reviews. Policies related to open space and wetlands preservation are administered by local agencies with no involvement from the Drain Commissioner.

4. Few local governments in developing areas of the County are anticipating the need to install stormwater retention facilities or drains to manage stormwater outside of the new developments. Local officials hope that the on-site retention policies administered when site plans and subdivision plats are reviewed will avoid flooding problems downstream as well as on-the-site.

5. Although many stormwater management requirements administered by local governments have stormwater quality benefits, these benefits are not commonly recognized. Only a small number of local governments (less than ten) consciously view stormwater management as being directly related to environmental resource management.

The implication of these findings for the implementation of stormwater quality measures is clear. In Oakland County, there are established regulatory programs which provide a basis for stormwater quality management. It is expected that technical information and assistance will lead to the incorporation of certain stormwater quality methods into local programs. The incentives which have led to the development of retention requirements ...namely, financial savings (when compared with storm sewers) and concerns about court cases and downstream flooding, will support stormwater quality measures as well. To be implemented, however, stormwater quality measures must be relatively low cost and low in maintenance.

Other counties in Southeast Michigan, however, do not have in place the institutional system for stormwater management which exists in Oakland County. Stormwater management requirements which have direct water quality benefits are less frequently followed, and only a small number of local governments have adopted stormwater regulations related to the on-site retention and detention of stormwater. It is possible, however, that the concerns which have led to stormwater detention regulations in Oakland County will be persuasive in other counties as well. Moreover, drain commissioners potentially can provide leadership for local governments in the area of stormwater quality control.

EFFECTIVE LOCAL GOVERNMENT STORMWATER MANAGEMENT PROGRAMS

The purpose of this section is to outline the elements of effective local government programs. The information of this section is based on several sources of information:

1. Recommendations from the Urban Nonpoint Advisory Committee of the Southeast Michigan Council of Governments;

2. A selective review of stormwater management programs in other states which have focused on stormwater retention and environmental management;

3. The Oakland County Report; and

4. The experience of case study communities with stormwater management.

The case study communities were selected because of their experience with stormwater management problems. It is anticipated that the history of each community's efforts as well as their present programs and standards will be useful source materials for other communities. The case study communities are located in different physical settings (see Figure 5):

- City of Farmington Hills (Oakland County) - A rapidly developing suburban community dominated by rolling hills and wooded lots (Rouge River watershed).

- Oakland Township (Oakland County) - A rural township with agricultural lands and scattered wetlands and woodlands (Clinton River watershed).

- Pittsfield Township (Washtenaw County) - A township characterized by rapid urbanization in areas adjacent to the City of Ann Arbor but with substantial remaining agricultural and rural lands. The terrain in Pittsfield Township is flat with scattered lowland and poorly drained areas (Huron River, Stony Creek, and Saline River watersheds).

- City of Sterling Heights (Macomb County) - A rapidly developing suburban community characterized by flat, low lying topography (Clinton River watershed).

- City of Troy (Oakland County) - A suburban community characterized by rapid growth over the past decade. Although most of the terrain is flat, the northwest quadrant has gently rolling lands with scattered woodlots (Clinton River and Rouge River watersheds).

The types of stormwater management programs which have evolved in each community reflect their physical settings, potential stormwater problems, and perception of local officials.

Local government stormwater management programs should be directed toward the interrelated and complementary goals:

- The enhancement of stormwater quality; and

- The control of stormwater flows in order to avoid flooding and maintain instream water levels.

In the past, most local governments have directed stormwater management programs toward a single goal -- the control of flooding. Managing stormwater quality does not need to involve chemical treatment of stormwater or other expensive measures. On-site stormwater retention through basins and the use of natural areas and wetlands can provide important water quality benefits. With little additional cost and with many additional benefits, stormwater can be managed for both quantity and quality control purposes.

Within the goals of stormwater quality and flooding control, local government stormwater management programs can incorporate multiple objectives. For example, one local government may direct its stormwater management efforts toward flood prevention and open space protection. Another local government may direct stormwater management efforts toward flood prevention, groundwater enhancement, and wetlands protection. Although the particular objectives vary, in both cases the local governments recognize the potential for multiple benefits from stormwater management.

Three types of stormwater management program activities should be carried out through local government programs:

- Stormwater management planning and intergovernmental coordination;
- Stormwater management regulations controlling new developments; and
- Stormwater facility construction, inspection, and/or maintenance.

Each program area, of course, should include specific program elements or activities which reflect the existing stormwater problems and future stormwater management opportunities for that particular community. Financing options should be considered as part of planning and program development.

Recommended Stormwater Management Planning Activities

Planning is the process of identifying present and potential stormwater problems as well as opportunities for addressing the problems. The planning process consists of several distinct steps:

- Development of program objectives;
- Data collection and analysis;
- Identification of alternative strategies;
- Evaluation of alternative strategies and selection of the most feasible approach;
- Implementation of the recommended approach through the establishment of appropriate programs; and
- On-going program monitoring.

Planning for stormwater management focuses on the development of policies and programs for carrying out the policies. Of necessity, it should include communication and coordination with other local governments within the watershed.

Public participation in local stormwater management planning programs is also important. Stormwater management policies and programs often affect the appearance, resources, development, and finances of the community. Members of the public have the right to be informed of program options and to advise local elected officials of their preferences.

Examples of stormwater management planning activities which are possible components of local programs are listed below. Perhaps more than any other category of stormwater management program activities, planning activities will vary with the particular needs of a local government. Some of the activities outlined can be carried out by existing government staff members at a very low cost. Other activities require special funding commitments.

Development of Program Objectives

1. Define stormwater management issues, problems, and concerns, including stormwater problems and potential future problems.

2. Identify potential program objectives. Will the proposed stormwater management program address recreational use of stormwater facilities? Protection of open space areas for multiple purposes? Groundwater or wetlands protection?

Data Collection and Analysis

3. Organize a data base which displays the natural and man-made system for stormwater conveyance and storage. Natural features identified should include wetland and lowlands, stream channels, floodplains, drainage basins, and areas of steep slopes. Manmade features include storm drains and retention/detention facilities. If possible, data should be organized and mapped at a detailed scale and related to property boundaries for use in reviewing development plans.

4. Assess the present stormwater conveyance and storage system. What problems are presently created? If future development occurs, what problems will occur?

5. Review the natural hydrologic system in the community, including surface and groundwater flows. If stormwater is retained on-site, what will happen to surface and groundwaters? Is there a need for water conservation? Can stormwater management and environmental protection needs be combined?

6. Identify storm flows from upstream communities and their impact on the community. Identify stormwater volumes discharged from the community and potential downstream effects. Identify intergovernmental issues which should be addressed during the planning process.

7. Examine existing policies, regulations and programs which affect stormwater. What is the effect of existing regulations on stormwater runoff? What are the views of developers regarding the regulations?

8. Project future population and land use trends to identify future volumes of stormwater runoff. (Projections should be made with the assumption of no stormwater management program or no expansion of existing programs.)

Identification of Alternative Strategies

9. Identify alternative approaches to managing stormwater for quantity and quality control purposes.

   - Is a regulatory program for controlling runoff in developing areas needed?
   - Does the community wish to allocate certain allowable runoff volumes to different areas of the community?
   - Are public acquisition programs needed to provide areawide or community stormwater retention/detention areas?
   - Are physical structures such as storm drain pipes needed for stormwater conveyance?

Evaluation of Alternative Strategies and Selection of the Most Feasible Approach

10. Evaluate alternative management strategies in terms of costs, benefits, and political feasibility. The short- and long-range effects of stormwater management policies on energy, environment, inflation, and resources should be identified.

11. Evaluate the impacts of stormwater strategies on other public programs, such as highways, utilities, and recreation programs. Are effects beneficial? Can alternative stormwater strategies be further expanded or modified to encompass objectives of several programs?

12. Review alternative strategies with citizens and decisionmakers. Representatives from developers and builders organizations should participate in the review. Public information concerning the costs and benefits of stormwater management should accompany the review of alternatives.

13. Select and adopt the most appropriate stormwater management strategy and related regulations and programs.

Implementation of Recommended Approach

14. Identify program management responsibilities and develop a schedule for detailed program planning.

15. Prepare a manual which describes the stormwater management program, including regulations and review procedures. The manual should include all development regulations which affect landowners and developers, and should assist the landowner in submitting development plans for review and approval. In effect, a manual creates a "no surprise" situation by providing clear, explanatory materials.

16. Prepare and distribute public information and education materials concerning the stormwater management program in order to assure public understanding and to facilitate public support. Community meetings and workshops may be useful at several points in the planning process.

Ongoing Program Monitoring

17. On a periodic basis, review stormwater management policies, programs, and regulations to identify effects. Review approaches to strengthening programs, as needed.

Technical assistance from watershed councils, county drain commissioners, the Michigan Department of Natural Resources, and the Southeast Michigan Council of Governments may be useful in local government stormwater management planning. Technical assistance needs must be identified by the local jurisdiction, however, and organized into a logical planning and program development effort.

Recommended Stormwater Management Regulatory Activities

The regulation of new development to assure proper management of stormwater runoff is of central importance for local government stormwater management programs. When runoff is properly managed in new developments, the need for costly remedial facilities in the future can be avoided. The costs of stormwater facilities in new developments are usually paid by the developers. The costs of government regulatory programs can be charged to landowners when development plans are submitted.

In all cases, regulations should be formally adopted by the local governing board. Unless regulations are adopted, there may be confusion concerning the scope of local government requirements. Adopted standards provide clear direction to technical staff and consultants, assure uniformity of requirements, and provide a legal framework if law suits should arise. Variance procedures to take into account hardship situations may also be useful.

In developing the stormwater regulatory program, the local community has several options:

1. To require on-site retention/detention of stormwater for all new developments;

2. To require on-site retention/detention of stormwater only in cases where the receiving waterway is small;

3. To require the developer to pay a fee or dedicate land as part of a community retention/detention facility; or

4. To allow discharge of runoff directly into surface water bodies.

A combination of these policies is often useful. For example, through planning, several community or areawide stormwater retention/detention areas could be identified. Only developments draining into the areas would be subject to community retention/detention facility regulations. In all other areas of the community on-site retention or detention of stormwater would be needed.

Although on-site retention and detention of stormwater often provides benefits for water quantity and quality control, there are several exceptions. If a community is at the downstream end of a watershed, for example, retention may actually increase flood peaks. Increased peaks occur if the discharge of stormwater from the community coincides with the arrival of upstream flood waters. When developing retention policies, downstream communities should carefully consider upstream flow rates, existing stream capacities, and water quality benefits related to stormwater retention. The design and location of retention and detention basins also affects their benefits. Careful engineering design and review is needed to assure proper functioning and maximum community benefits.

In certain instances, retention or detention of stormwater on the site may not be needed for flood control purposes. For example, if the site is adjacent to a large lake or major river, the contribution of stormwater from the development may not pose an immediate flooding problem. However, two important questions should be asked before retention/detention requirements are waived:

- If all of the developable lands in the subwatershed area become urban, will the river or lake be able to handle the stormwater runoff?

- Will stormwater runoff create water quality problems?

Recognizing the multiple benefits from on-site retention/detention and the desirability of having uniform requirements for all developments, some communities always require on-site retention or detention of stormwater, regardless of the size of the receiving stream or lake.

The particular type of facility used to provide on-site stormwater retention or detention will vary among developments and among communities. Some local governments prefer dry detention basins with shallow sides because they are low in maintenance and can be used as open recreation spaces during dry weather. Other communities prefer attractively designed permanent retention basins which function as lakes or wildlife ponds. Several communities in Southeast Michigan intentionally use wetlands and lowland areas as stormwater retention areas. Dished parking lots, grassed swales, or shallow depressions are often used for detention on sites smaller than an acre.

Historically, detention basins have been disliked by citizens and officials because of their nuisance characteristics. Basins have been viewed as temporary, pending the construction of larger storm drains or channels. Reflecting their temporary nature, little attention has been placed on the appearance of basins. Excavated pits with fences have been constructed to hold stormwater. As a result of changing philosophies, technical information, and financial restrictions, many retention/detention facilities are now considered to be permanent. Engineers, planners, and planning commissions are encouraging developers to integrate retention/detention facilities into the development with attention to appearance and recreational use potential.

The following guidelines are recommended for local government stormwater regulatory programs:

1. Through the review and approval of development plans, ensure that stormwater runoff is controlled on the site with appropriate retention/detention facilities and areas. Stormwater discharged from the site should not create flooding, low water levels, or water pollution problems.

2. Developments where stormwater runoff can be stored in community or areawide retention/detention areas, require a special retention fee or dedication of land in lieu of on-site retention or detention facilities.

3. Whenever soils permit, use natural depressions, swales, wetlands, and lowlands to retain stormwater and provide a slow release to groundwaters. The use of natural drainage areas such as these can save facility construction costs while providing attractive areas within the development. Stormwater retention in natural areas often has added water quality benefits.

4. Restrict stormwater runoff discharges to a pre-development or agricultural rate (this rate is often estimated to be 0.1 - 0.2 cfs/acres).

5. Manage stormwater runoff from minor storms (10-year frequency storms) and major storms (100-year frequency storms). Both routing and storage should be considered. Stormwater routing and storage for minor storms can usually be provided in a way which is attractive and avoids local flooding. Stormwater runoff areas for major storms are often overflow areas from the minor storm.

6. Require stormwater easements for major flow routes and retention areas. Easements should protect stormwater areas from obstructions and provide entry for maintenance purposes.

7. Through the review of development plans, minimize the amount of paved surface on the site. Cluster development options such as "planned unit developments" and "planned residential developments" can reduce impervious surface and provide open spaces which have stormwater retention benefits.

8. When natural areas such as depressions and wetlands provide significant retention benefits, the required capacity of retention/detention basins or dished parking areas should be reduced by a corresponding amount.

9. Require the developer to indicate the velocity and volume of stormwaters entering and leaving the site for use in planning stormwater facilities.

10. Control erosion, sedimentation, and stormwater runoff during site development and construction. In all cases, development plans and grading plans should be reviewed to minimize the area of exposed soils and erosion potential. Erosion and sedimentation permits (as required by state law for properties one acre or more in size or within 500 feet of a river or lake) should specify the measures to be used to control erosion and sedimentation.

11. Encourage developers and engineers to provide stormwater retention/detention facilities which have low maintenance costs.

12. Coordinate local government stormwater management regulations with state permit requirements. For example, large retention basins may require a Dam Construction Approval Permit or Inland Lakes and Streams Permit from the Michigan Department of Natural Resources.

13. Provide for on-site inspections during construction to assure conformance with approved development plans.

Stormwater regulations for the new developments should encourage innovative designs and layouts. Performance standards that provide adequate quantity and quality control but which do not dictate the shape or appearance of the retention/detention facility are recommended. The shape, location and appearance of stormwater facilities should be determined by qualified engineers following a careful review of the site.

Recommended Stormwater Facility Design, Construction, and Maintenance Activities

The program area of stormwater facility design, construction, and maintenance can be divided into two categories:

- Design and construction of areawide stormwater facilities, including storm drains and retention facilities; and

- Maintenance of public and private stormwater facilities.

Activities related to each category are outlined below.

The design and construction of areawide stormwater facilities, including the acquisition of natural lands and the construction of retention/detention basins, is a relatively new area of local government activity. In a number of cases, the use of larger, community retention/detention areas can provide added stormwater management and financial benefits. Local governments engaged in such projects should first undertake stormwater planning to identify the locations of potential areawide retention/detention facilities and develop a financial strategy. In some cases, the local government will need to acquire land, construct, and maintain areawide facilities.

The maintenance of stormwater retention/detention areas and facilities (including natural and man-made retention/detention areas) is essential for continued functioning. The necessity of trash removal, grass cutting, and other housekeeping practices is generally recognized. Regular pump maintenance is also recognized. Because many retention/detention basins and areas are new, structural maintenance needs including sediment removal and repairs have often not become apparent. Nevertheless, the clear experience of communities which have had retention/detention basins in place for ten or more years is that regular maintenance is essential.

Local government programs related to facility design, construction, and maintenance will obviously reflect the local government's approach to governmental services. In a rural community where the local government provides a minimum of public services, direct involvement in facility design, construction and maintenance will often be difficult. In such cases, the role of the local government is to assure that some other party or agency (such as the drain commissioner) is responsible for facility maintenance and areawide facility construction. In jurisdictions where community planning and public works services and programs are in place, the expansion of programs to include stormwater management may not be difficult. In the area of maintenance, for example, trucks and other equipment needed for sanitary wastewater treatment facility activities are often useful for stormwater facility maintenance.

Realizing that local government will have different program response capabilities, the following guidelines are recommended for consideration in the program development process:

1. Consider the feasibility of acquiring wetlands and lowland areas to serve as areawide stormwater retention/detention areas (this is also related to stormwater management planning). Can existing parks and recreation lands acquisition programs be used to meet stormwater management needs?

2. Define the types of maintenance required by certain types of stormwater facilities. If at all possible, provide for public inspection of all retention/detention basins to ensure that proper maintenance has been carried out. Special development fees may be required to finance a continuing retention/detention basin inspection program.

3. Assure that retention/detention basin maintenance is a clearly assigned responsibility. The type of maintenance activity to be carried out should be understood by the responsible party and the local government. In cases where homeowner associations or individual property owners are to be responsible for retention basin maintenance, agreements which allow the local government to step in and complete necessary maintenance activities in the event maintenance is not performed are recommended.

4. Consider the feasibility of a public retention/detention basin maintenance program financed through developer fees.

As reflected by these guidelines, the specific features of a local government stormwater facility maintenance or areawide facility construction and maintenance program will vary. Effective stormwater management, however, does necessitate some type of inspection and maintenance program.

SUMMARY OF LEGAL OPINION

The ultimate question to be answered, if NURP best management practices are technically feasible, is whether authority exists for local government officials to regulate development in order to attain stormwater quality objectives, including maintenance measures. A legal opinion that addressed this question was requested and is summarized below.

No Michigan statute has been found which expressly sanctions governmental regulation directed toward the quality of stormwater runoff. This is perhaps understandable in light of the fact that only within the last 10 years have studies identified stormwater runoff as a major nonpoint source of pollution in streams and lakes, including the Great Lakes. With the exception of the Soil Erosion and Sedimentation Control Act, which applies to the construction phase of development, such pollution has yet to be made the focus of specific legislative attention in Michigan. In the absence of such a statute, the question remains whether more might be done by adoption of ordinances at the local level. To this, the answer is a qualified "yes". Accumulation of phosphorus and BOD in stormwater runoff can and does lead to eutrophication of local bodies of water. Where such a situation is found to exist on a local level, it would be constitutionally permissible to recite that fact as the premise justifying local zoning regulations which might require, for example, retention of stormwater for periods sufficient to permit natural infiltration. Care would have to be taken, however, to make sure that the local problem could be documented. In addition, the local pollution problem must be of sufficient gravity to justify the local regulation.

A way to implement a thorough program for stormwater quality without local ordinances or specific state statutes could be by use of the Michigan Environmental Protection Act, Act No. 127 of Michigan Public Acts of 1970, MSA 13.528(201) et seq. ("MEPA"). MEPA has its basis in a provision of the Michigan Constitution of 1963 which avoids some limitations involving the police power. That provision, Article IV, Section 52 states as follows:

> The conservation and development of the natural resources of the state are hereby declared to be of paramount public concern in the interest of the health, safety and general welfare of the people. The legislature shall provide for the protection of the air, water and other natural resources of the state from pollution, impairment and destruction.

This language has the effect of satisfying one of the two tests of valid exercise of the police power whenever officials, acting under appropriate implementing legislation, undertake to protect the air, water and other natural resources of the state. In such activity, there is no longer any question about the presence of a valid governmental interest to be advanced, and since it is the resources of the state which must be protected, that interest may be served by local officials if they are empowered to act under appropriate legislation.

Section 5(2) of MEPA does address the actions of local officials in the following terms:

> In any...administrative, licensing or other proceedings, and in any judicial review thereof, any alleged pollution, impairment or destruction of the air, water or other natural resources or the public trust therein, shall be determined, and no conduct shall be authorized or approved which does, or is likely to have such effect so long as there is a feasible and prudent alternative consistent with the reasonable requirements of the public health, safety and welfare.

There is no express rule-making power contained in the MEPA nor is there any legislative guidance as to what activities are likely to impair the water or other natural resources of the state, or what measures should be taken to avoid such impairment. Still, it is apparently open to local agencies or officials who are given the administrative responsibility of plat approval, site plan approval or the issuance of permits in connection with developmental activity, and whose authority relates to stormwater drainage generally, to routinely determine that the same conditions which required measures for controlling the volume and velocity of stormwater runoff also require measures to protect runoff quality.

It should be noted that MEPA's direction to agencies to determine environmental improvement is not self-executing. Pollution or impairment must first be "alleged". However, under Section 5(1), any governmental agency or other legal entity may be permitted to intervene in an administrative or licensing proceeding on the filing of a pleading which asserts the likelihood of environmental impairment. There appears to be no reason why such a pleading could be routinely filed by a local official pursuant to resolution of a local governing body, taking the form of a statement that if a particular site were to be developed without installation of specified stormwater quality devices, environmental impairment would be likely to result. The question of impairment would be determined by the licensing body after hearing from the developer on the subject. Appropriate safeguards could be required on a case-by-case basis.

Assuming that installation of a required device constitutes "a feasible and prudent" environmental alternative which is "consistent" with the reasonable requirements of the public health, safety and welfare, an administrative agency is authorized to withhold its approval, license or permit unless a suitable commitment from the developer is forthcoming. Such a commitment might cover both installation and maintenance of an appropriate device.

MEPA presents a locally available vehicle suited to addressing statewide environmental concerns relating to stormwater quality, and no other state legislation has been found which adequately does the job. While enactment of local zoning ordinances under the police power is also an available means of addressing the same concerns, systematic use of MEPA may provide local officials with needed flexibility in dealing with stormwater quality.

STORMWATER MANAGEMENT OPTIONS FOR SOUTHEAST MICHIGAN

Based upon the stormwater management issues described in the preceding sections, SEMCOG developed stormwater management program options for local communities. The three options for strengthening stormwater management programs in Southeast Michigan are outlined in this section. The options represent different actions for improving the existing management system.

All options are based upon the premise that stormwater management for both stormwater quantity and quality control purposes is important. Since the pattern of local government stormwater management programs is uneven at the present time, implementation of each option involves change in present programs.

The options include the following:

Option #1: Existing Laws and Programs

- Using existing laws and agency programs, planning programs and stormwater regulations for quantity and quality control purposes would be encouraged. Through information and technical assistance efforts, local governments would be encouraged to adopt policies and standards for inclusion in site plan review procedures. Stormwater management programs would remain a local option.

Option #2: Amendments to the Subdivision Control Act

- Recognizing that new subdivisions provide important opportunities to manage stormwater, amendments to Michigan's Subdivision Control Act (Act 288, P.A. of 1967) would be proposed. Amendments would authorize county and local agencies to adopt stormwater management regulations for both quantity and quality control. Local agencies would have the option of proposing subdivision stormwater regulations for approval by the county drain commissioner.

Option #3: Comprehensive State Stormwater Management Legislation

- Under this option, a new state law would be drafted and introduced in the Michigan Legislature to provide a comprehensive management framework for planning, construction, and regulation of stormwater facilities. The new law could mandate watershedwide planning, to be completed in accordance with state guidelines. Watershed plans would be approved by county drain commissioners and the Michigan Department of Natural Resources, before implementation by county and local agencies.

The major features of each law related to stormwater management program components are indicated on Table 7 and Table 8. The options vary in terms of types of management programs allowed or mandated. Legal requirements and administrative aproaches for stormwater management also vary.

The options have been formulated to address different ways in which stormwater management issues can be resolved. The options address varying issues, with only Option #3 approximating an approach to resolving all current problems and providng a comprehensive approach to stormwater management.
PTION #1: EXISTING LAWS AND PROGRAMS

Legal Authority

- City or Village Zoning Act (Act 207, P.A. of 1921, as amended)
- Township Rural Zoning Act (Act 184, P.A. of 1943, as amended)
- Subdivision Control Act (Act 188, P.A. of 1967)
- Soil Erosion and Sedimentation Control Act (Act 347, P.A. of 1972)
- Michigan Drain Code (Act 40, P.A. of 1956)
- Michigan Environmental Protection Act (Act 127, P.A. of 1970)

TABLE 7

OVERVIEW OF STORMWATER MANAGEMENT OPTIONS

MANAGEMENT OPTION / PROGRAM COMPONENT	OPTION #1 EXISTING LAWS AND PROGRAMS	OPTION #2 AMENDMENTS TO THE SUBDIVISION CONTROL ACT	OPTION #3 COMPREHENSIVE STATE STORMWATER MANAGEMENT LEGISLATION
STORMWATER REGULATIONS (quantity & quality)	Local and county option	County regulations for subdivision plats; Local option	County and local regulations in compliance with watershed plan
STORMWATER PLANNING	Local option	Not addressed	Required at watershed level
STORMWATER FACILITY MAINTENANCE	Local option	Required through county or local subdivision plat reviews	Required at county and local level

Each of the three stormwater options provides for local government stormwater quantity and quality control programs throughout Southeast Michigan. Option #1 (Existing Laws and Programs) is a voluntary management system at the local level. Option #2 requires stormwater quantity and quality reviews of subdivision plats by county drain commissioners, but leaves local reviews as a local option. Option #3 mandates watershed planning and county and local regulations in conformance with the plans.

These options are not mutually exclusive and may be pursued simultaneously. The options represent alternative directions for continuing stormwater management efforts by the Southeast Michigan Council of Governments.

TABLE 8

MANAGEMENT ISSUES AND PROGRAM OPTIONS FOR STORMWATER QUANTITY AND QUALITY CONTROL

STORMWATER MANAGEMENT ISSUES / STORMWATER MANAGEMENT OPTIONS	OPTION #1: EXISTING LAWS AND PROGRAMS	OPTION #2: AMENDMENTS TO THE SUBDIVISION CONTROL ACT	OPTION #3: COMPREHENSIVE STATE STORMWATER MANAGEMENT LEGISLATION
1. Lack of Adopted Zoning Standards for Stormwater Management	*		✓
2. Lack of Uniform Stormwater Management Requirements Among Local Governments	*		✓
3. Lack of Uniform Stormwater Management Requirements Among Counties (and within Individual Watersheds)	*		✓
4. Local and County Agency Duplications of Subdivision Plat Reviews		✓	
5. Lack of County Drain Commissioner Legal Authority for Site Plan Reviews			✓
6. Lack of Ongoing Stormwater Management Planning			✓
7. Lack of Stormwater Facility Maintenance Programs		✓	✓

Key: * Can be addressed through information education programs.

✓ Issue is addressed in the management option.

Agency Responsibilities

Local governments and county drain commissioners would continue to review development proposals for stormwater impacts under the authority of several different Michigan laws. Local government could, if they wished, adopt policies and standards for stormwater quality and quantity control. The Southeast Michigan Council of governments and other agencies would provide technical information on stormwater quantity control measures which also have water quality benefits.

Program Description:

The current mix of county and local government stormwater management programs would continue under this option. County drain commissioners would review and approve stormwater facilities in proposed subdivisions. In some cases, advice on stormwater facilities for site plans would be provided by the counties.

The particular legal and administrative approach to stormwater regulations would vary among local governments. Reflecting current trends, local governments would be encouraged to apply performance-oriented standards to both subdivision plats and site plans. Each local government would develop review regulations and planning programs to meet the needs of the jurisdictions; local governments would not be required by state law to address stormwater issues. The Southeast Michigan Council of Governments and other agencies would provide technical information to encourage stormwater management for both quantity and quality control purposes.

Local governments would review existing and potential future stormwater management problems in their community, document their findings, and adopt appropriate policies, standards, and ordinances. In some cases, stormwater requirements would be included in zoning ordinances; in other cases, advisory plans or engineering standards would be used in reviewing development proposals. The Michigan Environmental Protection Act could be referenced in zoning ordinances and/or referenced in a notice to developers explaining the extent of environmental reviews.

Although communitywide and watershedwide planning for stormwater management would be encouraged, it would not be required. In view of limited funds for planning, citizen advisory groups and existing agency resources would be tapped to the extent possible.

As is presently the case, the pattern of local government stormwater planning and regulations would be varied across the region. Local responses would reflect local perception of issues and needs, as well as the success of information and education efforts.

Implementation Actions:

1. The Southeast Michigan Council of Governments, watershed councils, and other agencies would provide written materials and sponsor conferences on stormwater management measures for quantity and quality control. Whenever possible, individual contacts with local planning commissions and governing boards would be made to provide background on stormwater management strategies.

2. Interested local governments would document stormwater problems and concerns within their jurisdictions, and adopt appropriate plans and performance standards for stormwater quantity and quality control.

3. To provide an extremely strong legal basis for stormwater management reviews of development proposals (as well as other environemntal reviews), local governments would incorporate provisions of the Michigan Environmental Protection Act (MEPA) into ordinances and local review procedures. The Southeast Michigan Council of Governments would provide background information on administrative methods allowed by the law.

Advantages:

1. New state laws or enabling legislation are not needed to carry out this alternative; as a result, it can be carried out immediately.

2. This alternative emphasizes the importance of local stormwater planning and regulations. Local governments often are the first reviewers of development proposals (preceding county and state agency reviews, if needed), and can integrate stormwater facilities with other programs such as recreation, floodplain management, and wetlands protection.

3. The Southeast Michigan Concil of Governments is in the process of preparing technical assistance materials for local governments concerning detention basin engineering designs for stormwater quantity and quality purposes. Through research completed by the Washtenaw County Drain Commissioner, information on using wetlands, wet retention basins, and on-line basins for stormwater mamagement, is currently available.

Disadvantages

1. This alternative does not assure that stormwater management planning and regulation will be carried out where they are most needed. Implementation of effective programs throughout Southeast Michigan will depend upon voluntary responses from local agencies.

2. Without a clear state law related to stormwater management, local governments may be subject to political pressures to avoid stormwater management regulations.

3. This alternative does not resolve the issue of local and county duplications for subdivision plat reviews.

4. This alternative does not provide for county drain commissioner reviews of all site plans, unless such a review is requested by the local government.

OPTION #2: AMENDMENTS TO THE SUBDIVISION CONTROL ACT

Legal Authority:

Proposed amendments to the Subdivision Control Act (Act 288, P.A. of 1967

Agency Responsibilities:

Agency responsibilities for stormwater management would remain essentially the same (see Option #1). The only additional responsibility would be the review and approval of local government stormwater regulations by county drain commissioners. If approved, local governments would review subdivision plants in lieu of a county-level review.

Program Description:

For the past several years, state officials have discussed the need for revisions in the Subdivision Control Act. Although the law established a review and approval system for subdivision plats which was needed in 1967, several administrative and technical aspects of the law raise questions or pose problems. It is possible that the Governor will appoint a special study committee, perhaps with staff assistance from the Michigan Department of Treasury, to examine and review possible changes to the law.

Stormwater review requirements for subdivision plats is one area where technical and administrative questions have arisen. Since stormwater management needs in Southeast Michigan are very different from other areas of the State, it is appropriate for a special examination of stormwater aspects of subdivision plat reviews be conducted.

The following changes to the Subdivision Control Act could be recommended:

1. The need for stormwater management for quality and quantity control purposes: A statement of findings at the introduction of the Act could be added which clarifies the public purposes and need to manage stormwater.

2. Definition of adequate stormwater facilities: Section 192 of the present law requires the county drain commissioner or the governing body of the municipality in which the subdivision is situated, whichever has jurisdiction, to require the following: "That the proprietor provide for adequate storm water facilities within the lands proposed for platting and outlets thereto." The meaning of "adequate facilities" is not indicated.

   To clarify the scope of the county or local subdivision review, wording could be added to state: "That the proprietory provide for stormwater facilities within the land proposed for platting and outlet thereto which provide appropriate quantity and quality control of runoff and prevent flooding and pollution. The terms "flooding" and "pollution" would also be defined.

3. Stormwater facility maintenance: The law could be amended to require county and/or local review agencies to require regular stormwater facility inspections and maintenance as a condition of subdivision plat approval. Deed restrictions or agreements with governmental agencies performing maintenance services could be required.

4. County approval of local government regulations: A new section could be added to the Subdivision Control Act providing for the review and

approval of local government stormwater regulations by the county drain commissioner. The purpose of the county review would be to assure consistency with county subdivision review standards. Local government standards could be more stringent than requirements of the county drain commissioner.

5. After approval of local government regulations, a regular county review of stormwater facilities in subdivisions would not be completed. At the option of the local government or the land owner, a special county review could be requested and paid for.

6. State guidelines for subdivision plat reviews: The Michigan Department of Natural Resources would prepare advisory guidelines for local government to use in preparing stormwter management regulations.

These recommended changes address two stormwater management issues: (1) the present duplication in local and county agency subdivision reviews which occurs when local government adopt their own regulations; and (2) the need for stormwater facility maintenance on a regular basis.

Amendments to the Subdivision Control Act will not insure that all local governments with potential stormwater problems will adopt needed programs. The proposed amendments also do not change the scope of drain commissioner's authority; it would remain focused on subdivision reviews and connections to designated county drains. This option is intended to remedy certain problems in the subdivision review process -- it is not a comprehensive approach to stormwter maangement.

Impelemntation Actions:

1. An interagency committee involving drain commissioners, local officials, watershed councils, and SEMCOG will be organized to develop a legislative strategy.

Advantages:

1. In addition to clearly defining the scope of stormwater reviews to include both qantity and quality concerns, this option would eliminate double stormwater reviews of subdivision plats.

2. This option provides a vehicle for assuring that all stormwater facilities proposed for subdivisions are maintained.

3. Stormwater regulation at the local level remains a local option. At the same time, a countywide framework for local government regulations is provided.

Disadvantages:

1. This option would reqire careful planning and legislative efforts, while only addressing several of the current stormwater management issues in Southeast Michigan.

2. Amendments for the Subdivision Control Act as proposed above would not provide a comprehensive county stormwter regulatory system; site plan reviews would continue to only be completed at the request of local agencies.

3. The inclusion of stormwater quality as a goal in a stormwater management program remains a local option -- there is no guarantee that needed quality control measures would be implemented.

OPTION #3 COMPREHENSIVE STATE STORMWATER MANAGEMENT LEGISLATION*

Legal Authority:

New Michigan Law to be drafted and enacted. (One possible approach is outlined below.)

Agency Responsibilities:

The Michigan Department of Natural Resources would prepare rules and regulations to implement the new law.

County drain commissioners, regional planning agencies, and watershed councils would establish cooperative interagency planning programs to prepare stormwater management plans for certain designated basins (such as the Rouge, Clinton, and Huron in Southeast Michigan). County drain commissioners would review and approve plans and transmit them to the Michigan Department of Natural Resources for further review and approval.

Local governments would be required to prepare and adopt stormwater management regulations in conformance with the watershed plan. County drain commissioners would review and approve local regulations and programs.

Program Description:

New statewide stormwater mangement legislation would emphasize the following purposes:

1. To encourage planning and management of stormwater runoff in each watershed which is consistent with sound water and land use practices.

2. To authorize a comprehensive program of stormwater management designed to preserve and restore the flood-carrying capacity of streams and lakes; preserve natural stormwater runoff regimes, flows, and water quality; and protect and conserve groundwaters and groundwater recharge areas.

3. To encourage local administration and management of stormwater consistent with Article IV, Section 52, of the Michigan Constitution which states the following:

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*Note: Elements of this option are based on the Pennsylvania Storm Water Management Act, P.L. 864, No. 167, adopted October 4, 1978.

> "The conservation and development of the natural resources of the state are hereby declared to be of paramount public concern in the interest of the health, safety and general welfare of the people. The legislature shall provide for the protection of the air, water and other natural resources of the state from pollution, impairment and destruction."

The Act would focus stormwater management activities on watershedwide planning and local government stormwater management regulations. Present authority of drain commissioners to review and approve subdivision plats to assure adequate stormwater facilities would not be altered. The Act would lead to the development of comprehensive local government programs for stormwater quantity and quality control.

Following the enactment of the new laws, The Michigan Department of Natural Resources would have six months to prepare technical assistance materials and advisory guidelines to assist agencies in implementing the Act.

Watershed plans for stormwater management would be required in urbanizing watersheds such as Clinton, Huron, and Rouge within a two-year period following passage of the Act. SEMCOG, watershed councils, and drain commissioners could meet together to select a "lead agency" for plan preparation purposes. County drain commissioners and the Michigan Department of Natural Resources would review and approve watershed plans.

Watershed plans would include the following:

- surveys of natural conditions
- assessment of stormwater management problems
- review of past, present and future land use trends
- identification of alternative runoff control techniques and their utility in the watershed
- a designation of areas to be served by stormwater collection and control facilities within a ten-year period
- an identification of the existing or proposed institutional arrangements to implement and operate the facilities
- criteria and standards for the control of stormwater runoff from existing and new development
- priorities for implementation

The state law would require watershed plans to be consistent with other existing local, county, regional, and state environmental and land use planning programs. Public participation would be encouraged and solicited throughout the plan development period.

The intent of the legislation would not be to establish large (more than $100,000 per watershed) planning effort involving extensive data collection, studies, and computer models. Instead, planning would use available data (and

the computer model available for the Clinton River Watershed) to define problems. Emphasis would be placed on reviewing options with local officials. Funding for planning would be included in the proposed legislative package.

The act would prohibit developers and persons engaged in land alteration from increasing the peak rate of stormwater discharge unless the discharge is controlled so that downstream damage is avoided. Retention/detention basins, porous pavements, grassed swales, wetlands used for stormwater retention, and protection of open spaces are examples of technical measures to be emphasized in the program. These types of technical measures help to achieve the dual purposes of quantity and quality control.

Following the adoption of the watershed stormwater management plan, local governments would be required to adopt appropriate regulations within a one year period. Local government regulations would be reviewed and approved by county drain commissioners to assure consistency with watershed stormwater management plans.

The provisions outlined here are based upon Pennsylvania's stormwater management law for issues in Southeast Michigan. SEMCOG welcomes additional suggestions on the content for a state law.

Implementation Actions:

1. Watershed councils, county drain commissioners, local officials, and SEMCOG would meet together as an interagency coordinating committee to determine a legislative strategy.

Advantages:

1. This option provides for stormwater management planning on a watershed basis as a framework for local government regulations. The watershed planning would help insure that each local government's regulations are compatible with neighboring communities.

2. Under this option, all local governments in developing watersheds would adopt stormwater management regulations addressing quantity and quality concerns.

3. This approach could address stormwater management concerns in developed communities. Options #1 and #2 primarily address stormwater management through development review regulations.

Disadvantages:

1. State or county funding to support planning and implementation programs may not be available.

2. Coordination of watershed plans across county lines might prove to be a difficult task.

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